2023 DRAFT COASTAL MASTER PLAN

RESTORATION IMPACTS ON SURGE AND RISK – COASTAL FORESTS

SUPPLEMENTAL MATERIAL H6.7

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COASTAL PROTECTION AND RESTORATION AUTHORITY

This document was developed in support of the 2023 Coastal Master Plan being prepared by the Coastal Protection and Restoration Authority (CPRA). CPRA was established by the Louisiana Legislature in response to Hurricanes Katrina and Rita through Act 8 of the First Extraordinary Session of 2005. Act 8 of the First Extraordinary Session of 2005 expanded the membership, duties, and responsibilities of CPRA and charged the new authority to develop and implement a comprehensive coastal protection plan, consisting of a master plan (revised every six years) and annual plans. CPRA's mandate is to develop, implement, and enforce a comprehensive coastal protection and restoration master plan.

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LIST OF ABBREVIATIONS

ADCIRC ..... ADVANCED CIRCULATION (MODEL)
CLARA ..... COASTAL LOUISIANA RISK ASSESSMENT (MODEL)
CPRA ..... COASTAL PROTECTION AND RESTORATION AUTHORITY
FT ..... FEET
FWOA ..... FUTURE WITHOUT ACTION
GIWW ..... GULF INTRACOASTAL WATERWAY
HSDRRS ..... HURRICANE AND STORM DAMAGE RISK REDUCTION SYSTEM
KTS ..... KNOTS
MB ..... MILLIBARS
MI ..... MILES
SLR ..... SEA LEVEL RISE
SWAN ..... SIMULATING WAVES NEARSHORE (MODEL)

1.0 INTRODUCTION

The coastal forests exploratory analysis aids in evaluating coastal flood risk for existing conditions, which include the presence of coastal forests and comparisons to a future in which the existing forests are converted to marsh. With increasing rates of sea level rise (SLR) and ongoing inundation of coastal areas, many coastal forests will gradually transition to freshwater marsh (Baustian et al., 2020; Visser et al., 2013; Visser & Duke-Sylvester, 2017). As coastal forests transition to marsh, their ability to attenuate storm surge and wave height lessens due to the loss of canopy and related changes in frictional resistance. Lower frictional resistance results in less water flow drag, and the loss of canopy exposes the water surface to higher winds and permits higher momentum transfer to the water, increasing surge and wave height.

To evaluate the potential coastal flood risk impacts resulting from the removal of coastal forests from the landscape, simulations were conducted assuming a future without action (FWOA) with coastal forests on the landscape (referred to herein as 'FWOA') and a FWOA without coastal forests on the landscape (referred to herein as 'FWOA without coastal forests'). All simulations used the lower environmental scenario (S07), and all results presented are for Year 10. FWOA S07 represents one of many possible futures for the Louisiana coast; therefore, results should be interpreted as plausible outcomes rather than likely predictions for future flood risk outcomes.

Five individual storms were selected from a larger suite of synthetic storms developed for the 2023 Coastal Master Plan and were used in this evaluation. Storms 164, 276, 281, 388, and 573 were selected based on their westerly track, making landfall west of Timbalier Bay at various storm track headings (from 320 to 40 degrees), forward speeds (from approximately 5 to 16 kts), and size (radius to maximum winds from 28 to 48 mi). The westerly tracks have the potential to produce more significant surge heights within the Barataria and Terrebonne basins, and the Maurepas Swamp, thus influence the upper reaches of the basins where coastal forests were removed as part of this analysis. Each storm produces peak water surface elevations with a 4 to 10% annual exceedance probability under current conditions.

The Advanced Circulation (ADCIRC) and Simulating Waves Nearshore (SWAN) models were used to simulate surge and wave heights for each of the five synthetic storms analyzed. Prior to the 2023 Coastal Master Plan, an extensive model validation and calibration was conducted by Cobell and Roberts (2021) to ensure that the parameters used within the model were most appropriate from those currently found within the modeling community and literature. The ADCIRC+SWAN model geometries used for the 2023 Coastal Master Plan were derived from those used in both the 2012 and 2017 Coastal Master Plans, with incremental upgrades made for each iteration. ADCIRC+SWAN

model version v55.00 was used in this work and represents the latest available enhancements to the model formulations at the time this effort was conducted.

Flood depth and damage results from each of the storms included in this analysis were simulated with the Coastal Louisiana Risk Assessment (CLARA) model. An introduction to the CLARA model can be found in Johnson et al. (2021), Fischbach et al. (2012), and Johnson et al. (2013). The CLARA model uses high-resolution hydrodynamic storm surge and wave output from ADCIRC+SWAN. It estimates flood depth exceedances; direct economic damage exceedances across different asset types, including residential, commercial, and industrial structures; expected annual damage; and expected annual structural damage in the Louisiana Coastal Zone. The analysis described herein only considered single storm runs rather than a probabilistic storm suite, so the results only estimate the direct economic damage associated with the storms that were simulated.

Coastal forests identified for this analysis at Year 10 were altered to represent marsh using the following methodology. First, coastal forests were identified, vegetation parameters were replaced with typical marsh parameters, including reducing the landscape frictional resistance (Figure 1), and finally the canopy effects and resulting sheltering offered by forests was removed through modification of the wind input files and ADCIRC wind parameter file. Selected storms were simulated with and without coastal forests, and storm surge and waves were compared for each of the five storms.

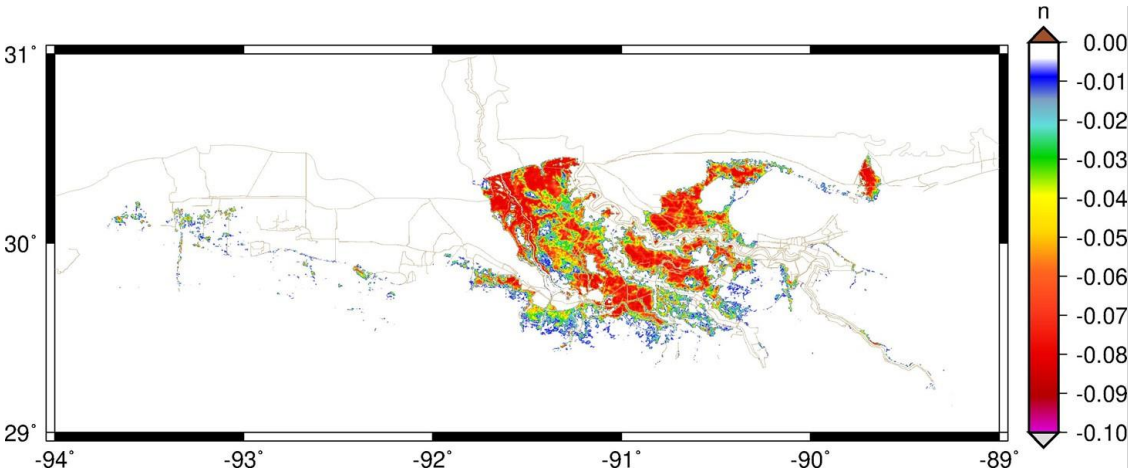

Figure 1. Spatial extent of changes and corresponding magnitude of reduction of the Manning's N resulting from the removal of coastal forests and conversion to marsh at Year 10. For the areas shown, there was a modification to the wind option to remove tree canopy and resulting sheltering effects.

2.0 MODEL OUTPUTS

2.1 STORM 164

Synthetic Storm 164 is a tropical storm with a track heading of approximately 320 degrees, trending across the bay side of Marsh Island, in the Atchafalaya Bay (Figure 2). The storm passes near Cypremort Point east of Vermilion Bay before making landfall in western Vermilion Bay southwest of Avery Island, west of the Atchafalaya River Delta. The storm has a forward speed of 5.9 kts, reference change in pressure of 48 mb, and radius to maximum winds of 37.5 mi.

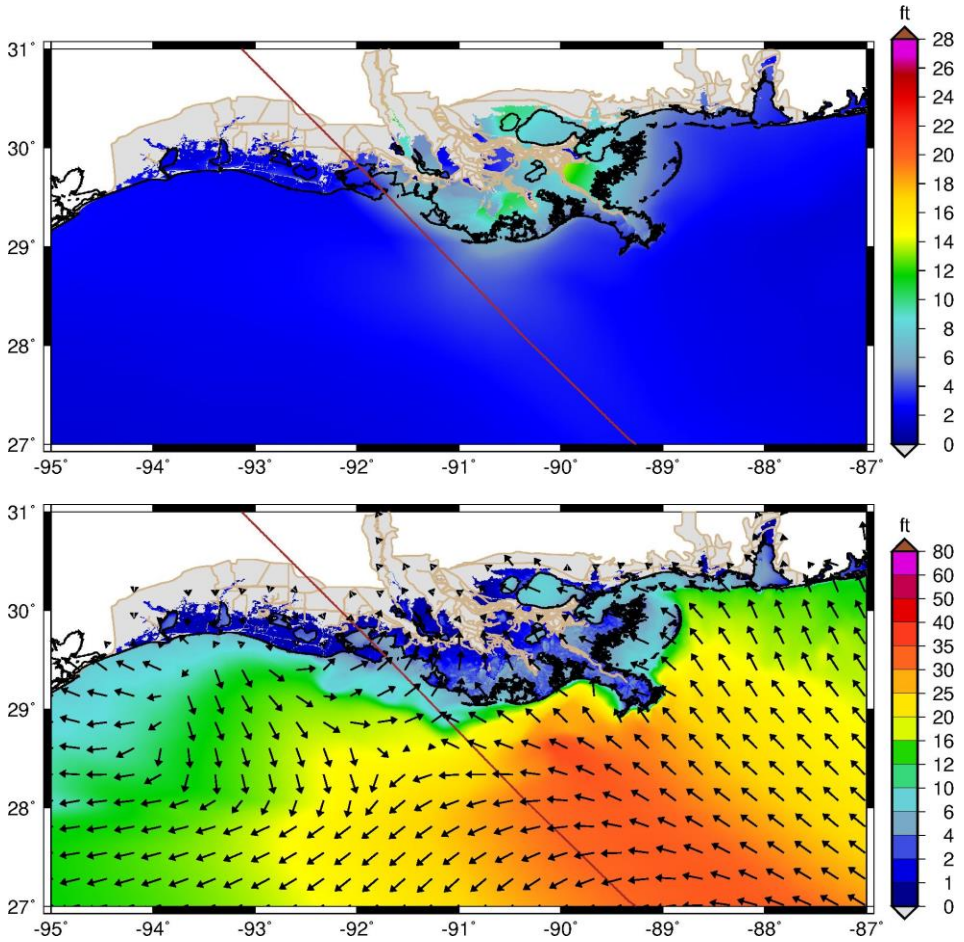

Figure 2. Track and heading for Storm 164 showing projected peak water surface elevation (top) and projected significant wave height (bottom) (FWOA, Year 10, S07).

SURGE AND WAVES

The ADCIRC+SWAN model was used to simulate storm surge and wave height for Storm 164 assuming a FWOA and a FWOA without coastal forests under S07 conditions. Results at Year 10 are presented below.

FWOA (YEAR 10)

At Year 10 under S07, ADCIRC simulations show that the anticipated surge from Storm 164 would be greatest to the east of the storm (Figure 3). While landfall would occur in the southcentral portion of Louisiana's coast near Vermilion Bay, simulations show that the highest surge levels would occur in the northern reaches of Terrebonne Bay, the upper Breton Sound Basin, and to a lesser extent the northwest areas of Lake Maurepas and Lake Pontchartrain. Simulations show that the highest expected storm surge, an estimated 14 to 15 ft, would be found in the upper Breton Sound Basin between Lake Borgne and the Mississippi River, an area that includes St. Bernard Parish and the portion of Plaquemines Parish located on the east bank of the Mississippi River. Storm surge is equally high in the northern reaches of Terrebonne Bay (10 to 12 ft) and reaches the same magnitude in northern Lake Maurepas. Throughout Lake Pontchartrain, most of Lake Borgne, Mississippi Sound, Bay St. Louis, and part of the lower Breton Sound and lower Barataria Basins storm surge is approximately 8 to 9 ft. Similarly, swaths of storm surge of the same magnitude (8 to 9 ft) can also be seen in eastern Atchafalaya Bay and Fourleague Bay, and in the backbarrier of Isles Dernieres near Lake Pelto (Figure 3).

Significant offshore wave heights resulting from Storm 164 south of the modern Mississippi River Bird's Foot Delta are predicted to exceed of 40 to 50 ft with a northwesterly direction, following the wind speed direction as the storm approaches land (Figure 4). Significant wave heights attenuate along the central Louisiana coast before making landfall. From the Caminada Headland to Sandy Point, just west of the delta, wave heights range from 10 to 12 ft. Similar wave heights are observed along the areas fronting the barrier islands in the Breton and Chandeleur sounds, with maximum wave heights occurring as the storm closes to a few miles from the shores. The wave heights are predicted to rapidly break before making landfall. Throughout Terrebonne and Barataria bays, significant wave heights are generally less than 6 ft, but to the east in Breton and Chandeleur sounds, the open coast allows for more wave transmission, as well as more local generation, and wave heights reach 8 to 10 ft. Further to the west, seaward of Atchafalaya Bay, wave heights range from 6 to 8 ft, and within the bay and near Vermilion Bay wave heights reduce to less than 6 ft (Figure 3; Figure 4).

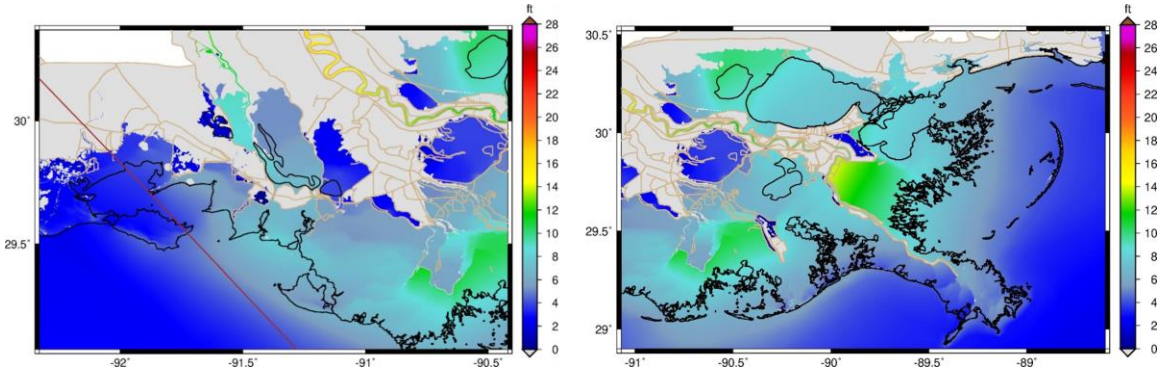

Figure 3. Peak water surface elevation (ft, NAVD88) along the southcentral (left) and southeast (right) Louisiana coast for Storm 164 (FWOA, Year 10, S07).

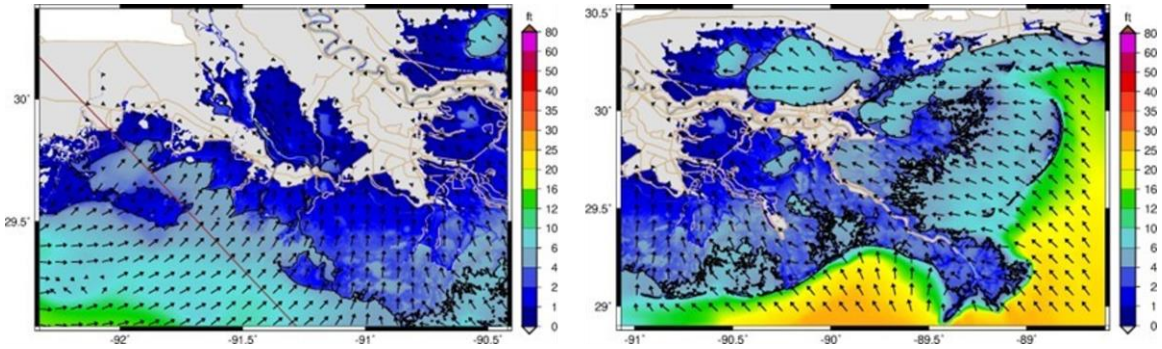

Figure 4. Significant wave heights (ft, NAVD88) along the southcentral (left) and southeast (right) Louisiana coast for Storm 164 (FWOA, Year 10, S07).

FWOA WITHOUT COASTAL FORESTS (YEAR 10)

ADCIRC+SWAN simulations of storm surge and waves for Storm 164 under a FWOA without coastal forests in Year 10 reveal similar spatial patterns in maximum surge and wave locations (Figure 5; Figure 7). One notable difference between the simulations is in locations immediately proximate to areas where coastal forests were converted to marsh. For example, similar levels of surge and waves are predicted in several areas of open water, including the Gulf of Mexico, the bays and sounds to the west (Terrebonne and Barataria bays) and east (Breton and Chandeleur sounds) of the Mississippi River Bird's Foot Delta, and within lakes Pontchartrain and Borgne (Figure 5). The lack of tree canopy and the conversion of forest to marsh accompanied with the lower frictional resistance, however, allow for larger storm surges to move inland landward of the locations of these forests (Figure 6). The change in storm surge (Figure 6) is on the order of 0.5 ft near the fishing communities located around Lac Des Allemands and the Lac Des Allemands Swamp, including the community of Des Allemands. Storm surge to the north of Lac Des Allemands is predicted to be higher, ranging from 1 to 1.5 ft. In

the upper Barataria Basin and throughout the Maurepas Swamp, surge from Storm 164 is predicted to exceed 1.5 ft. Beyond these direct surge impacts, backwater flooding from Storm 164 in a FWOA without coastal forests is expected to result in surge levels ranging from to 0.75 to 1.2 ft. in the Atchafalaya River south of the Gulf Intracoastal Waterway (GIWW) in the Atchafalaya Basin (Figure 6).

Similarly, ADCIRC+SWAN results indicate that wave heights will increase in the absence of coastal forests because winds can now more effectively push water inland and cause locally generated waves to grow. These locally generated waves reach 1 to 2 ft in the Maurepas Swamp, with higher waves close to 3 ft near transitions with the Pleistocene uplands. Some increase in wave heights is also seen in the northern Barataria upper waterways (i.e., Lake Cataouatche), the Pearl River Valley, and near the GIWW in Barataria Bay east (Figure 8).

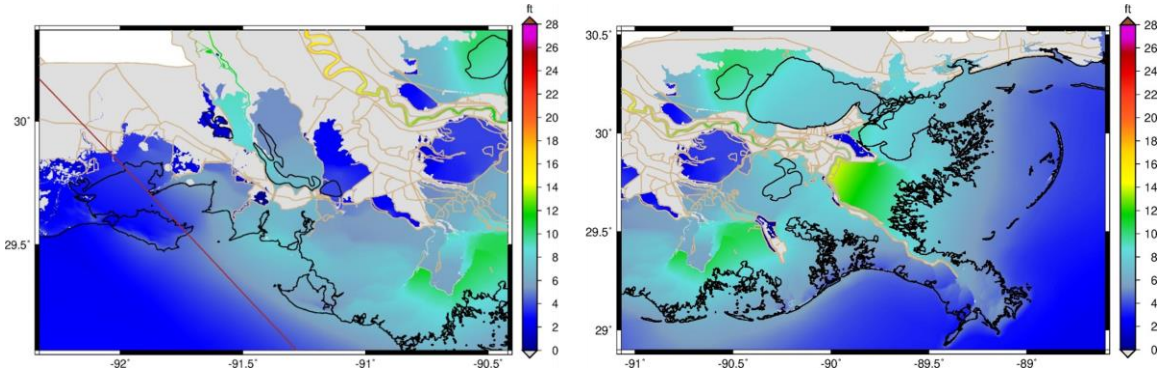

Figure 5. Peak water surface elevation (ft, NAVD88) along the southcentral (left) and southeast (right) Louisiana coast for Storm 164 (FWOA without coastal forests, Year 10, S07).

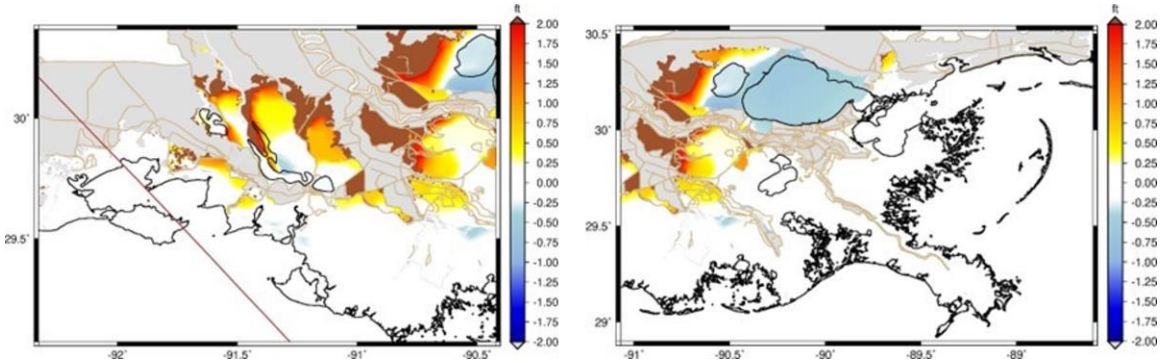

Figure 6. Change in peak water surface elevation (ft, NAVD88) along the southcentral (left) and southeast (right) Louisiana coast between FWOA and FWOA without coastal forests for Storm 164 (Year 10, S07).

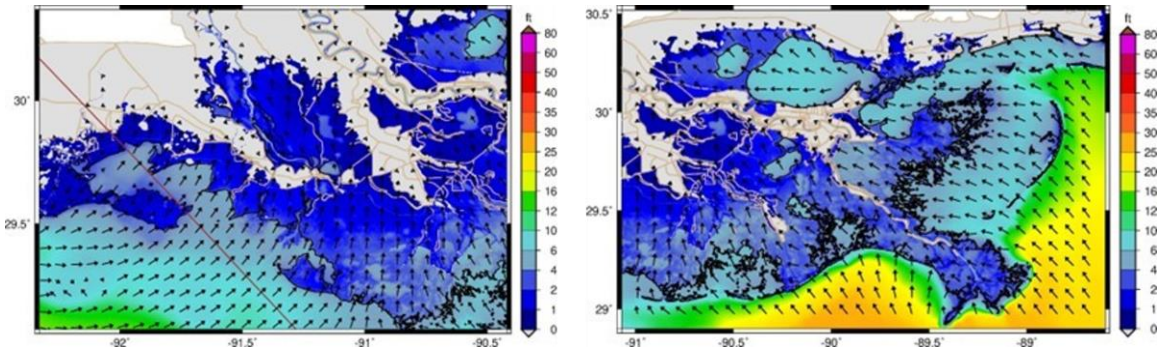

Figure 7. Significant wave heights (ft, NAVD88) along the southcentral (left) and southeast (right) Louisiana coast for Storm 164 (FWOA without coastal forests, Year 10, S07).

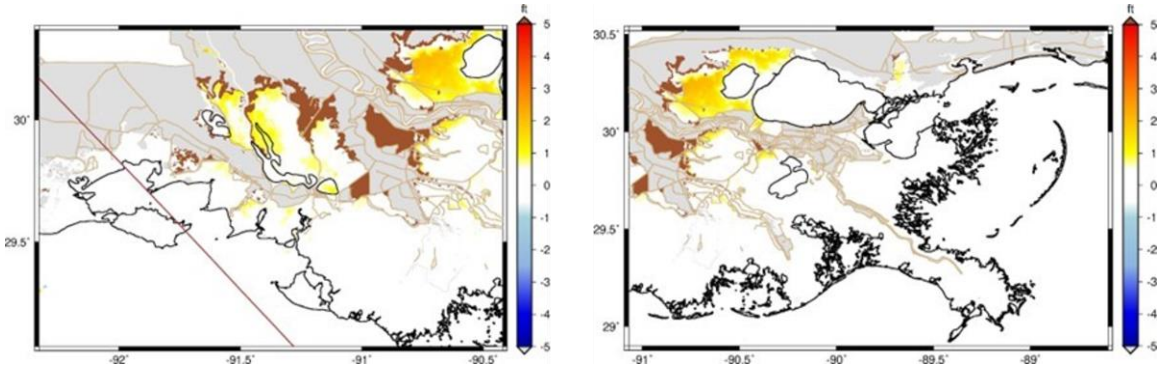

Figure 8. Change in significant wave height (ft, NAVD88) along the southcentral (left) and southeast (right) Louisiana coast between FWOA and FWOA without coastal forests for Storm 164 (Year 10, S07).

FLOOD DEPTH AND DAMAGE

The CLARA model was used to estimate flood depths and direct economic damage for Storm 164 assuming a FWOA and a FWOA without coastal forests under S07 conditions. Results for Year 10 are presented below.

FWOA (YEAR 10) FLOOD DEPTH

In a FWOA, the maximum flood depths from Storm 164 are expected to occur to the east of the center line of the storm. CLARA simulations show that the greatest depths are likely to be concentrated in two main coastal regions, Terrebonne and Breton Sound (Figure 9). The highest flood depth is shown to occur in the area near Braithwaite in the Breton Sound Basin, where the Hurricane and Storm Damage

Risk Reduction System (HSDRRS) levees on the south side of St. Bernard Parish and the Mississippi River levees could focus surge across Breton Sound. Other locations expected to experience high levels of flooding include the coastal wetlands in the Barataria Basin. Notable flooding is also anticipated to take place in the Pontchartrain Basin around lakes Pontchartrain and Maurepas, with the forested wetlands between these two lakes expected to experience an increase in flood depths. To the west of the storm track in the Chenier Plain Region, flood depths from Storm 164 are expected to be minimal, with slight increases in depths anticipated in locations adjacent to the estuarine lakes of the region and little penetration inland beyond the chenier ridges.

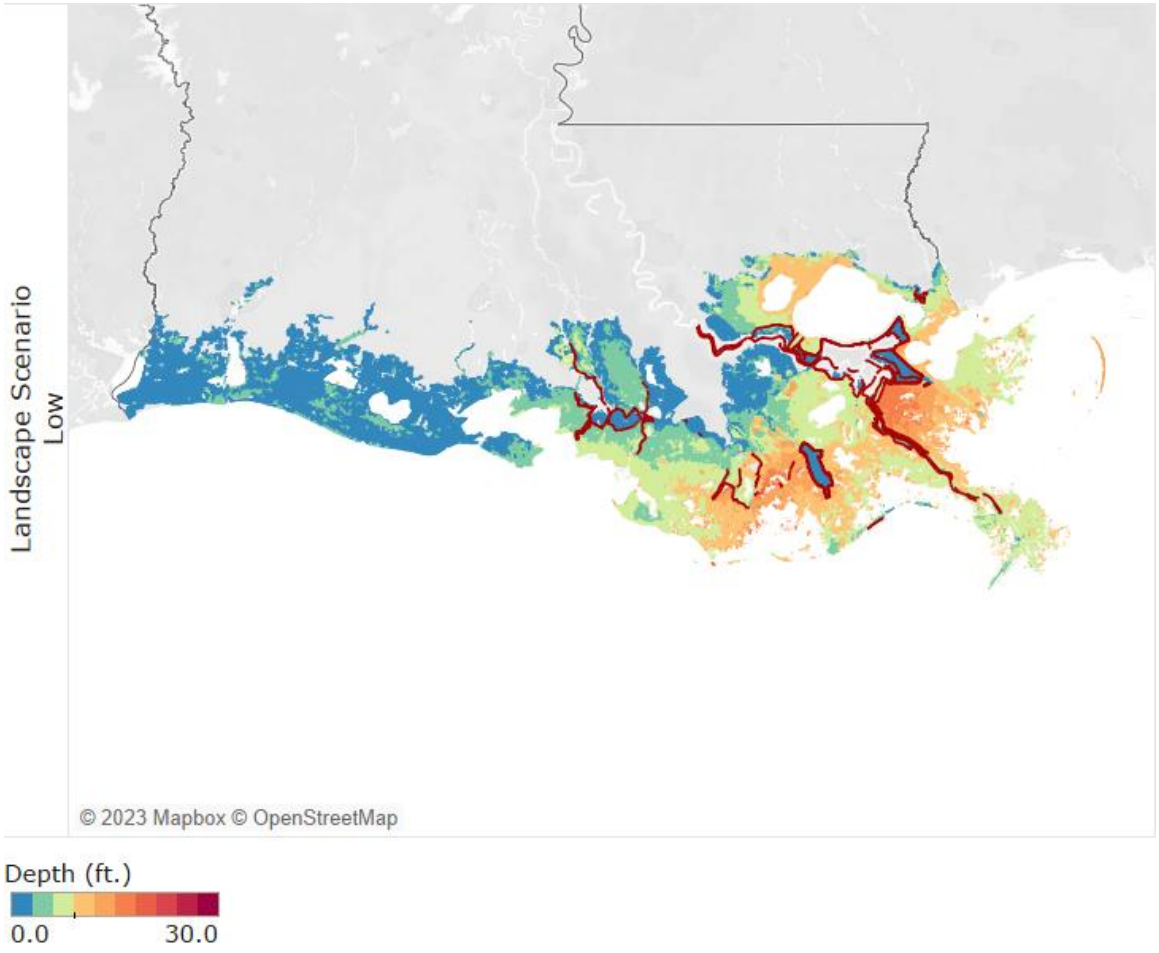

Figure 9. Maximum flood depth for Storm 164 with current levee alignments (FWOA, Year 10, S07).

FWOA WITHOUT COASTAL FORESTS (YEAR 10) FLOOD DEPTH

The removal of coastal forests is not expected to significantly alter the levels of flooding from Storm 164, with both Terrebonne Basin and Breton Sound still expected to experience the highest levels of flooding. However, an expansion of the floodplain is observed in the CLARA simulations in the locations surrounding Lac Des Allemands and Bayou Lafourche north of Larose and to the immediate east of the Atchafalaya Basin (Figure 10). The removal of coastal forests would have little to no impact to the west of the storm track.

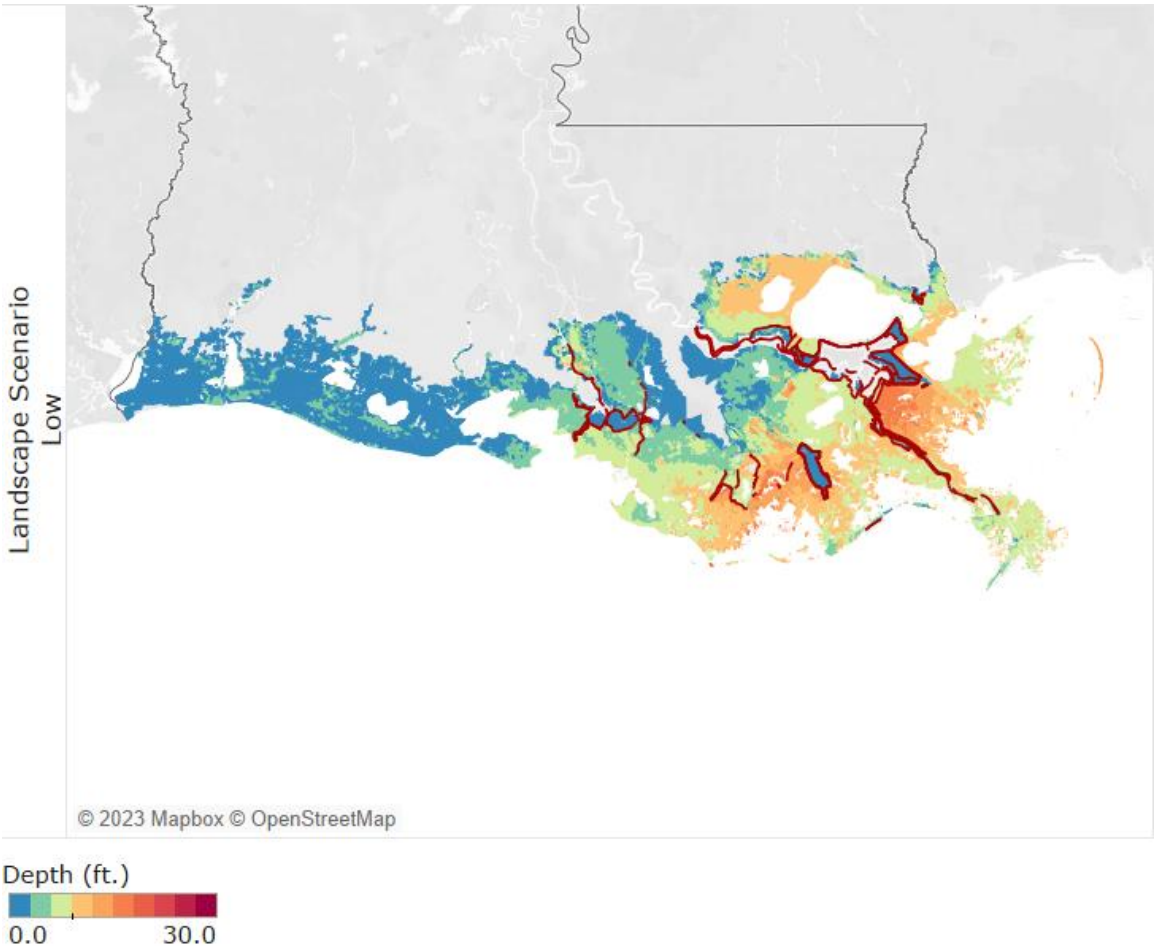

Figure 10. Maximum flood depth for Storm 164 with current levee alignments (FWOA without coastal forests, Year 10, S07).

FWOA (YEAR 10) ECONOMIC DAMAGE

CLARA simulations for Storm 164 generally show that in a FWOA, the distribution of economic damage is tied to both the locations of greatest flooding and the density of population and residential structures. The majority of direct economic damage from flooding resulting from Storm 164 in Year 10 is expected to be concentrated in the densely populated areas around Houma and nearby communities such as Bayou Cane and Bayou Blue (Figure 11). In addition, Storm 164 is expected to result in relatively high levels of damage along Bayou Lafourche, particularly in Thibodaux and the smaller communities located along the west bank of the bayou within the Larose to Golden Meadow system. South of Golden Meadow, outside the protection levee system, high levels of damage are anticipated in and around Port Fourchon, a high value industrial area.

Beyond these Terrebonne Region communities, Storm 164 is expected to result in moderate levels of economic damage in the Pontchartrain Basin, with the highest levels found in the Slidell/Eden Isle/Pearl River area on the north shore of Lake Pontchartrain. Both New Orleans and New Orleans East are expected to experience relatively high levels of economic damage and damage to structures. While the impacts of storm surge and wave impacts are not expected to be as high in these locations compared to other areas across the state, the density of population and development will likely result in a greater number of damaged structures, even if the degree of damage is not as high as other impacted communities.

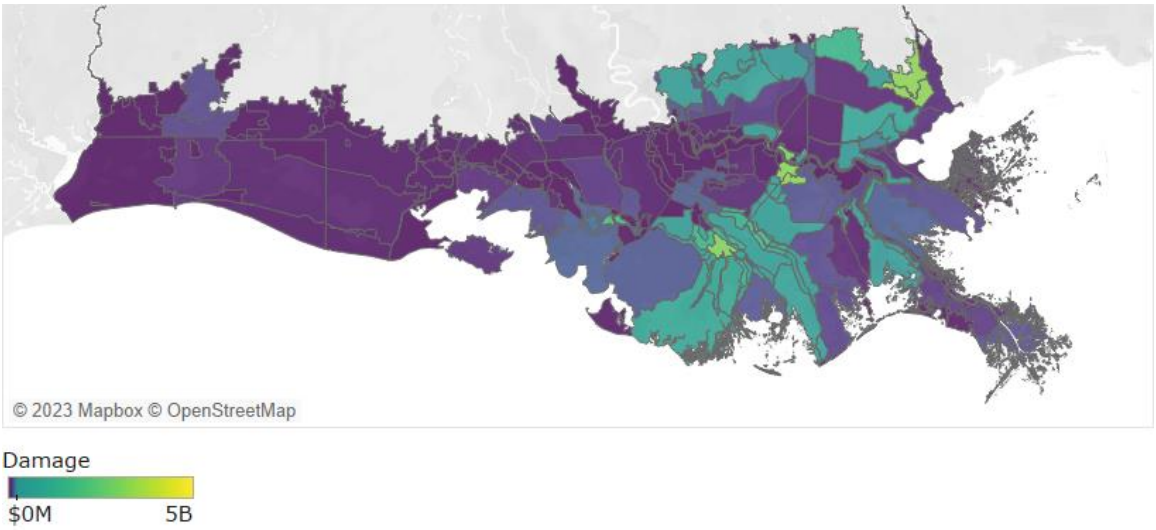

Figure 11. Future economic damage for Storm 164 (FWOA, Year 10, S07).

FWOA WITHOUT COASTAL FORESTS (YEAR 10) ECONOMIC DAMAGE

CLARA simulations suggest that the removal of coastal forests would have minimal impact on the overall coastwide damage footprint from Storm 164 in Year 10 (Figure 12). One notable area expected to see increased damages are the Ascension Parish communities of Gonzales and Prairieville, which are both highly developed southern suburbs of Baton Rouge. When the difference between flood damage in a FWOA with and without coastal forests is directly compared, these communities show the greatest level of anticipated damage increases without coastal forests (Figure 13).

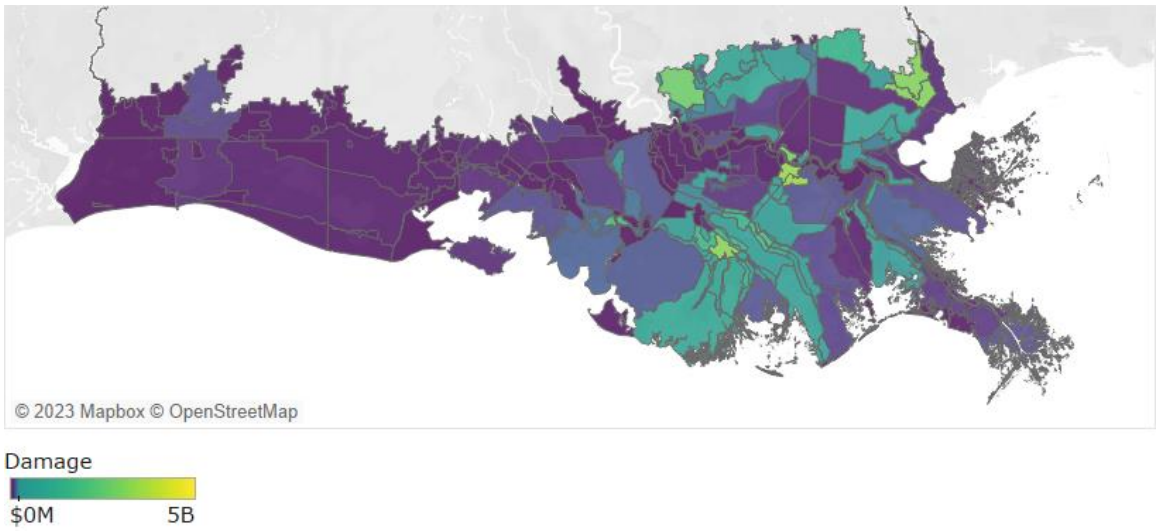

Figure 12. Future economic damage for Storm 164 (FWOA without coastal forests, Year 10, S07).

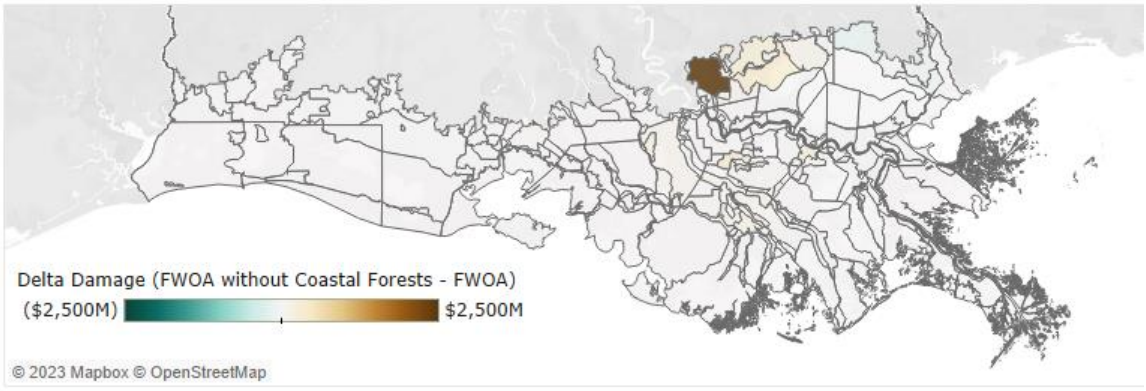

Figure 13. Change in future economic damage between FWOA and FWOA without coastal forests for Storm 164 (Year 10, S07).

In terms of total flood damage, CLARA results show that damage levels in the more densely populated areas facing higher levels of flood exposure are significantly higher than those in the sparsely populated portions of the coast. Gonzales and Prairieville are expected to experience the highest amount of damage from Storm 164 in a FWOA, both with and without coastal forests on the landscape (Table 1). When the forests are removed from the analysis, however, the damage values are expected to increase ten-fold. Other locations expected to experience similar or higher proportional increases in damage include River Parish communities such as Gramercy and Lutcher. The River Parishes refer to many of the parishes located along the Mississippi River between New Orleans and Baton Rouge and are generally considered to include Ascension, St. Charles, St. James, and St. John the Baptist parishes. Beyond the River Parishes, many of the fisheries-dependent communities located around Lac Des Allemands and the Lac Des Allemands Swamp, including Chackbay, Choctaw, and South Vacherie are projected to experienced increased damage levels when coastal forests are removed from the models. While the total flood damage is significantly less than in other communities, the Baldwin/Charenton area of St. Mary Parish, a location not anticipated to experience any flood damage in a FWOA with coastal forests, would be expected to have approximately $1 million in damages if the coastal forests were removed from the landscape.

Table 1. Communities expected to experience a 50% increase in flood damage from Storm 164 (FWOA and FWOA without coastal forests, Year 10, S07)

Community	Parish	FWOA Flood Damage (Year 10)	FWOA without Coastal Forests Flood Damage (Year 10)	Delta Damage % (FWOA without Coastal Forests - FWOA)
Choctaw	Lafourche	$7M	$108M	>1000%
Gramercy/Lutcher	St. James	$4M	$62M	>1000%
Pierre Part	Assumption	$14M	$190M	>1000%
Gonzales/Prairieville	Ascension	$251M	$2,722M	983%
New Iberia	Iberia	$2M	$14M	707%
Chackbay	Lafourche	$89M	$409M	359%
Baldwin/Charenton	St. Mary	$0M	$1M	324%
Port Vincent/French Settlement	Livingston	$23M	$90M	286%
Gibson	Terrebonne	$23M	$69M	193%
Ponchatoula/Springfield	Tangipahoa	$28M	$76M	168%
South Vacherie	St. James	$79M	$191M	143%
Franklin	St. Mary	$18M	$42M	138%
Bayou L'Ourse	Assumption	$7M	$13M	86%
Bayou Black	Terrebonne	$22M	$41M	83%
Thibodaux/Lafourche Crossing/Bayou Country Club	Lafourche	$95M	$162M	70%
Killona/Taft	St. Charles	$2M	$3M	50%

2.2 STORM 276

Synthetic Storm 276 is a tropical storm with a storm track heading of approximately 340 degrees, trending across the west of the Isles Dernieres barrier island chain on the western end of Raccoon Island (Figure 15). The storm passes through Caillou Bay before making landfall along the coast between Caillou Lake, Lost Lake, and Lake Merchant, west of Terrebonne Parish communities of Dulac and Dularge. The storm has a forward speed of 10.4 kts, reference pressure deficit of 58 mb, and radius to maximum winds of 46.1 mi.

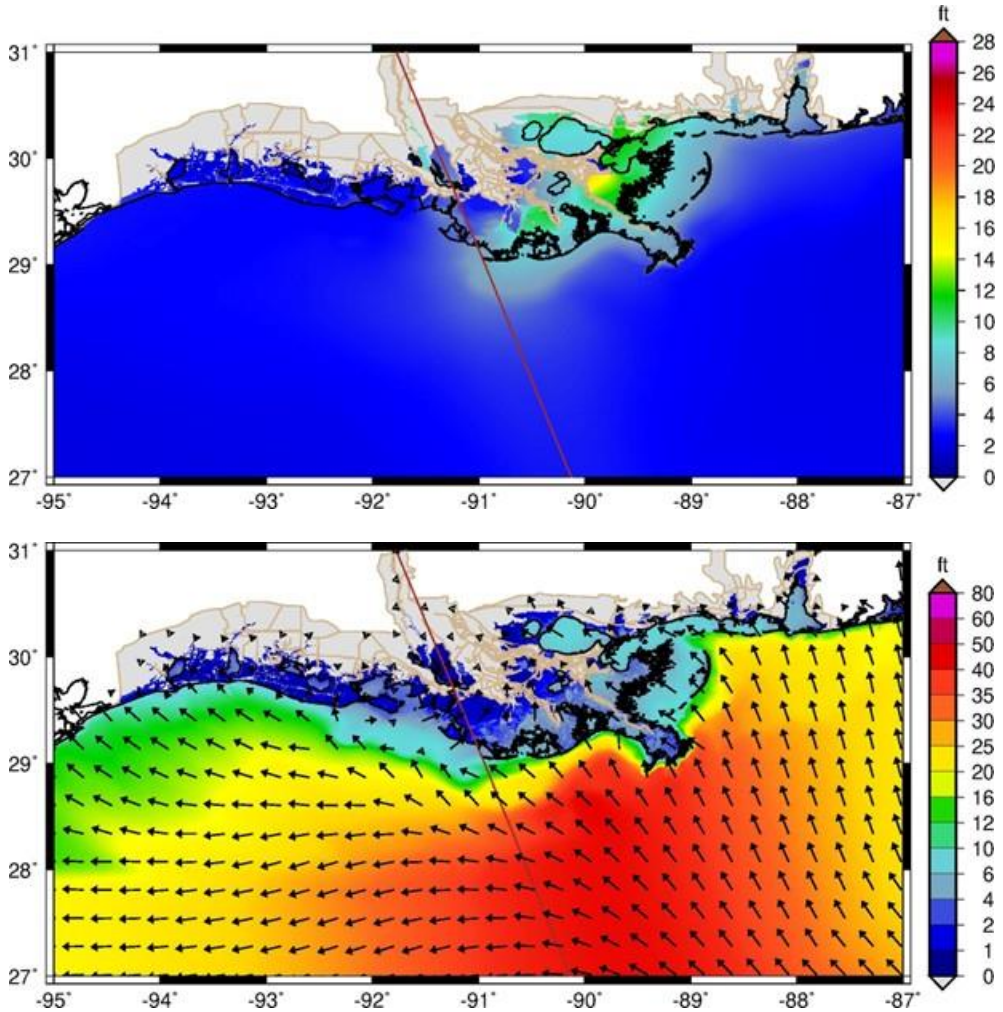

Figure 14. Track and heading for Storm 276 showing projected peak water surface elevation (top) and projected significant wave height (bottom) (FWOA, Year 10, S07).

SURGE AND WAVES

The ADCIRC+SWAN model was used to simulate storm surge and wave height for Storm 276 assuming a FWOA and a FWOA without coastal forests under S07 conditions. Results at Year 10 are presented below.

FWOA (YEAR 10)

At Year 10 under S07 conditions, ADCIRC+SWAN simulations show that the anticipated surge from Storm 276 would be greatest to the east of the storm (Figure 15). While landfall would occur in the southcentral portion of Louisiana's coast near Caillou Bay, simulations show that the highest surge levels would occur in the upper Breton Sound Basin near the location of the Carnarvon Freshwater Diversion (Figure 15). Simulations show that the highest expected storm surge, an estimated 14 to 16 ft, would be found in the upper Breton Sound Basin between Lake Borgne and the Mississippi River, an area that includes St. Bernard Parish and the portion of Plaquemines Parish located on the east bank of the Mississippi River. The highest surge levels are projected to occur at the Plaquemines Parish community of Braithwaite, located at the junction of the HSDRRS levees on the south side of St. Bernard Parish and the Mississippi River levees. Surge levels ranging from 10 to 13 ft are projected for many other locations throughout the Breton/Pontchartrain Region, including along a large swath of the Biloxi Marsh, Lake Borgne, and the Pearl River Valley. Slightly lower but notable surge levels on the order of 8 ft are anticipated throughout lakes Pontchartrain and Maurepas as well as the eastern Mississippi Sound and the area of the Chandeleur Sound proximal to the Biloxi Marshes.

To the west of the Mississippi River, ADCIRC+SWAN results for Storm 276 in a FWOA project storm surge levels from 10 to 13 ft along the northern reaches of Terrebonne Bay and most of the upper Barataria Basin south of Lake Salvador. This includes much of the area along the Larose to Golden Meadow levee system, which protects the densely populated Cut Off/Galliano/Golden Meadow community.

Significant offshore wave heights south of the modern Mississippi River Bird's Foot Delta are projected to reach as high as 50 ft, directed towards the northwest, following the wind speed direction as the storm approaches land (Figure 16). East of the delta, ADCIRC+SWAN results predict wave heights ranging from 16 to 20 ft in the areas fronting Breton Island and Chandeleur Islands. Landward of the barrier islands in lower Breton and Chandeleur sounds, the open coast allows for more wave transmission, as well as more local generation, allowing wave heights to reach 8 to 10 ft. These waves are expected to rapidly break as they near the coastline.

Similar patterns are observed west of the delta from Sandy Point to the Caminada Headland, where projected wave heights range from 16 to 20 ft offshore, attenuating before reaching the shoreline.

Throughout Terrebonne and Barataria bays, on the interior of the barrier island chains, significant wave heights are lower in magnitude, and generally range from 6 to 10 ft. Seaward of Caillou Bay, wave heights range from 4 to 6 ft, and are reduced to 2 to 4 ft as they move across Caillou Lake and Lake Mechant (Figure 16).

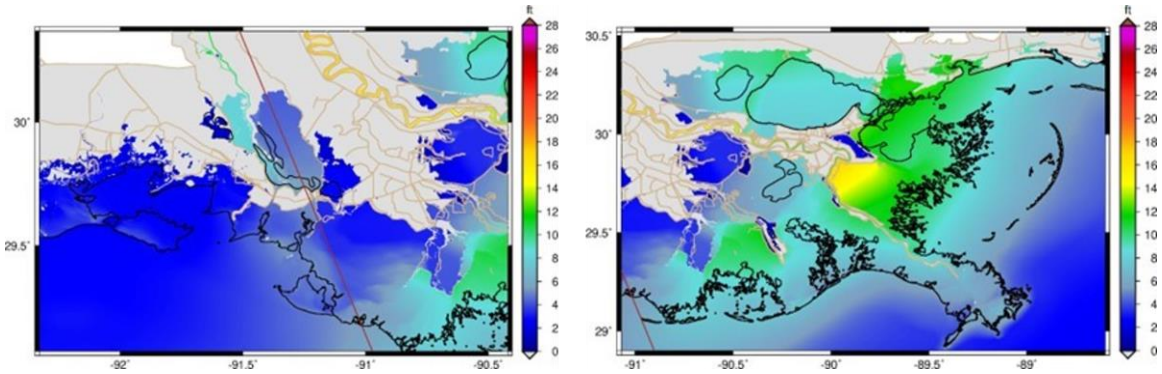

Figure 15. Peak water surface elevation (ft, NAVD88) along the southcentral (left) and southeast (right) Louisiana coast for Storm 276 (FWOA, Year 10, S07).

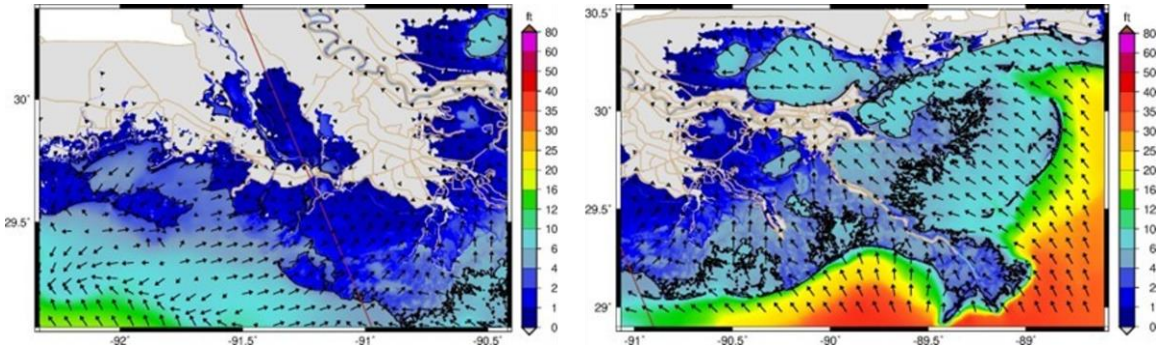

Figure 16. Significant wave heights (ft, NAVD88) along the southcentral (left) and southeast (right) Louisiana coast for Storm 276 (FWOA, Year 10, S07).

FWOA WITHOUT COASTAL FORESTS (YEAR 10)

Results of ADCIRC+SWAN simulations under a FWOA without coastal forests at Year 10 are similar to those found in the FWOA simulation with coastal forests in place (Figure 17; Figure 18; Figure 19; Figure 20). The greatest observed differences in the two landscapes are in those locations directly adjacent to the areas where the models converted coastal forests to marsh. Similarly, the removal of coastal forests is not expected to alter the surge and wave heights within lakes Pontchartrain and Borgne. In many inland areas, however, the lack of tree canopy and the conversion of forest to marsh

accompanied by lower frictional resistance, is projected to allow larger storm surges to move inland of the former locations of these forests (Figure 18; Figure 20). The greatest observed changes in storm surge resulting from the removal of coastal forests in the FWOA simulation of Storm 276 are expected to occur in the northern Barataria Basin between Bayou Lafourche and the Mississippi River, an area that includes Lac Des Allemands and the Lac Des Allemands Swamp (Figure 18). Surge levels of 0.5 ft are expected around the community Des Allemands. These levels are expected to reach upwards of 1.5 ft to the immediate north of Lac Des Allemands. In the upper Barataria Basin and throughout the Maurepas Swamp, surge from Storm 276 in a FWOA without coastal forests is projected to exceed 1.5 ft. Notably, a reduction in surge heights is evident south of Lake Maurepas near LaPlace, as well as along the landbridge separating Lake Maurepas from Lake Pontchartrain (Figure 18). Beyond the direct surge impact of Storm 276 in a FWOA without coastal forests, additional backwater flooding is expected to result in surge levels ranging from to 0.75 to 1.0 ft. in the Atchafalaya River north of the GIWW in the Atchafalaya Basin.

As seen in the storm surge results, wave heights are projected to increase in the absence of coastal forests because winds can now more effectively push water inland, increase water depth locally, and thereby cause locally generated waves to grow. In the Maurepas Swamp surrounding Lake Maurepas, wave heights of 1 to 2 ft are projected to occur from Storm 276 in a FWOA without coastal forests, with wave heights approaching 3 ft near transitions with the Pleistocene uplands along the perimeter of the swamp. Some increase in wave heights is also seen in the northern Barataria upper waterways (i.e., Lac Des Allemands), the Pearl River Valley, near the GIWW in eastern Barataria Bay, and north of Lake Maurepas near the North Shore community of Ponchatoula/Springfield (Figure 20).

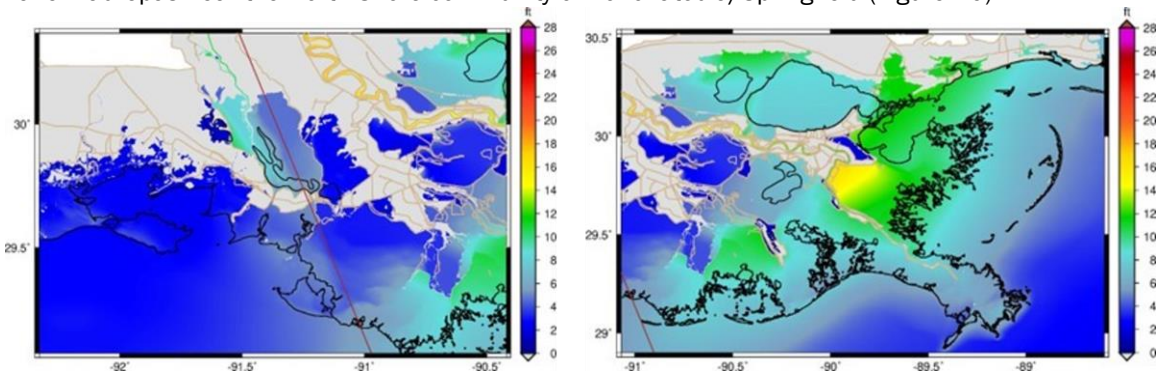

Figure 17. Peak water surface elevation (ft, NAVD88) along the southcentral (left) and southeast (right) Louisiana coast for Storm 276 (FWOA without coastal forests, Year 10, S07).

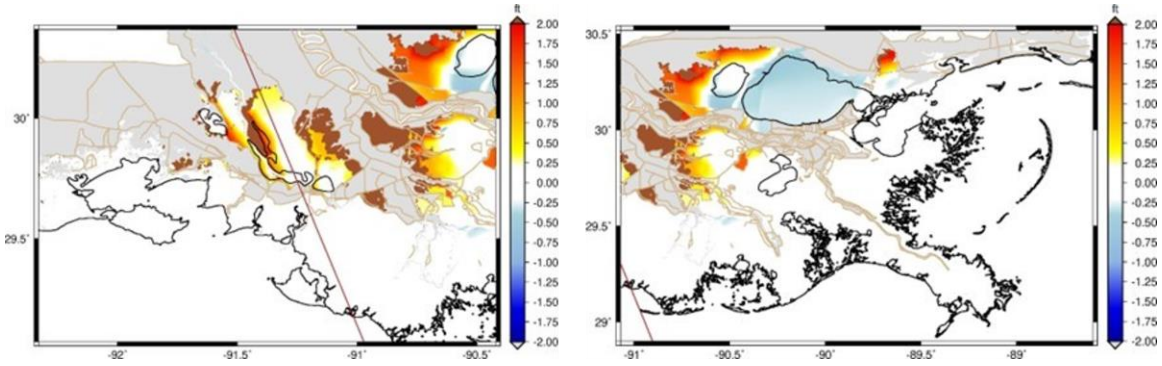

Figure 18. Change in peak water surface elevation (ft, NAVD88) along the south central (left) and southeast (right) Louisiana coast between FWOA and a FWOA without coastal forests for Storm 276 (Year 10, S07).

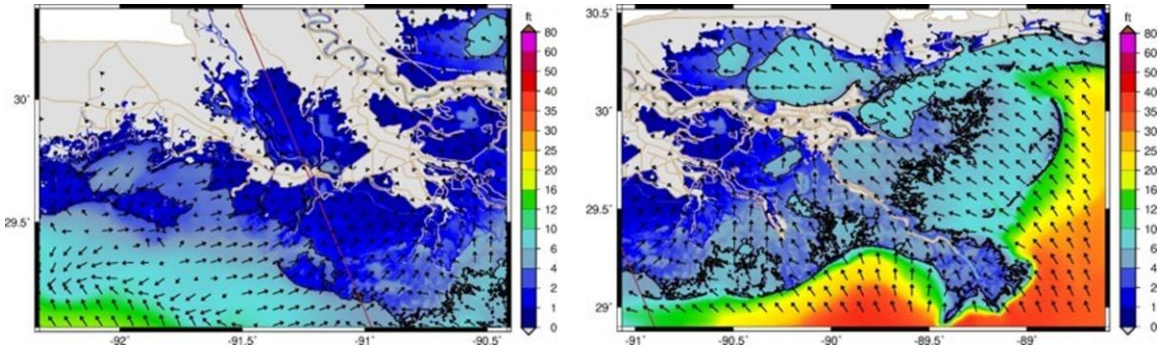

Figure 19. Significant wave heights (ft, NAVD88) along the southcentral (left) and southeast (right) Louisiana coast for Storm 276 (FWOA without coastal forests, Year 10, S07).

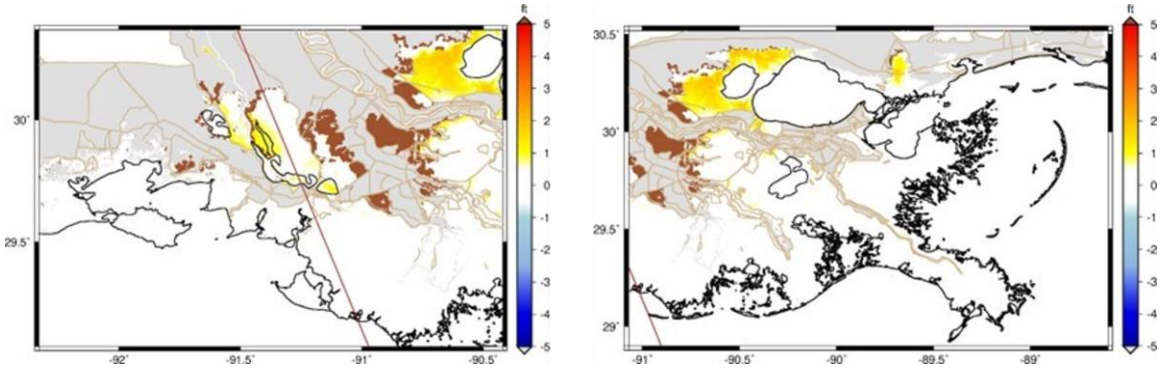

Figure 20. Change in significant wave height (ft, NAVD88) along the southcentral (left) and southeast (right) Louisiana coast between FWOA and FWOA without coastal forests for Storm 276 (Year 10).

FLOOD DEPTH AND DAMAGE

The CLARA model was used to estimate flood depths and economic damage for Storm 276 assuming a FWOA and a FWOA without coastal forests under S07 conditions. Results for Year 10 are presented below.

FWOA (YEAR 10) FLOOD DEPTH

In a FWOA, CLARA results show the maximum flood depths from Storm 276 are expected to occur far to the east of the center line of the storm, in Breton Sound between the HSDRRS levees on the south side of St. Bernard Parish and the Mississippi River levees, an area that coincides with the highest expected water surface elevations found in the ADCIRC simulations (Figure 21). Other locations expected to experience high levels of flooding include the coastal wetlands in the Terrebonne and Barataria basins. Notable flooding is also anticipated to occur in the marsh areas on the north shore of Lake Pontchartrain. CLARA results also show that the northwestern portion of the Pontchartrain Basin around lakes Pontchartrain and Maurepas is expected to experience significant flood depths in a FWOA focused on the forested wetlands between these two lakes. Similar to the results of the ADCRIC simulations, which show relatively little increase in surge and waves to the west of the storm track in the Chenier Plain Region, the CLARA results show that the flood depths from Storm 276 are expected to be minimal in southwest Louisiana. Slight increases in depths are anticipated along the southern shores of White Lake and Calcasieu Lake, as well as along many coastal chenier ridges in the region.

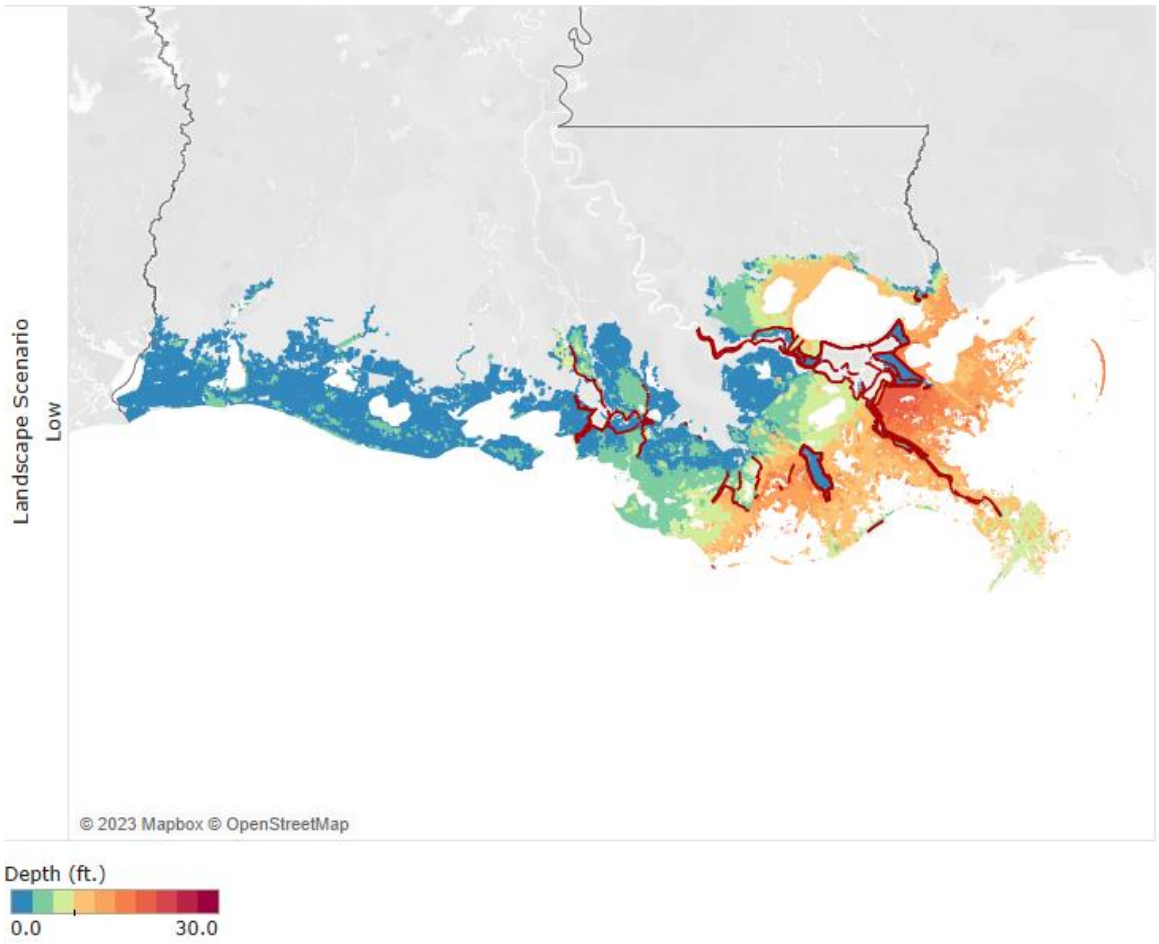

Figure 21. Maximum flood depth for Storm 276 with current levee alignments (FWOA, Year 10, S07).

FWOA WITHOUT COASTAL FORESTS (YEAR 10) FLOOD DEPTH

The removal of coastal forests in FWOA is not expected to significantly change the flood depths resulting from Storm 276 compared to a FWOA with the coastal forests in place (Figure 22). However, an expansion of the floodplain is expected to occur in the area between the west shore of Lake Maurepas and the River Parishes. CLARA results show that the area flooded under Storm 276 may extend from the western edge of Lake Maurepas westward toward Gonzales/Prairieville. CLARA outputs also show an expansion of the floodplain in the northern Barataria Basin, along upper Bayou Lafourche near its junction with the Mississippi River. This area includes incudes a combination of suburban and rural/agricultural development and is home to communities such as Belle Rose/ Paincourtville, Donaldsonville/Lemannville, and Napoleonville/Labadieville/Supreme.

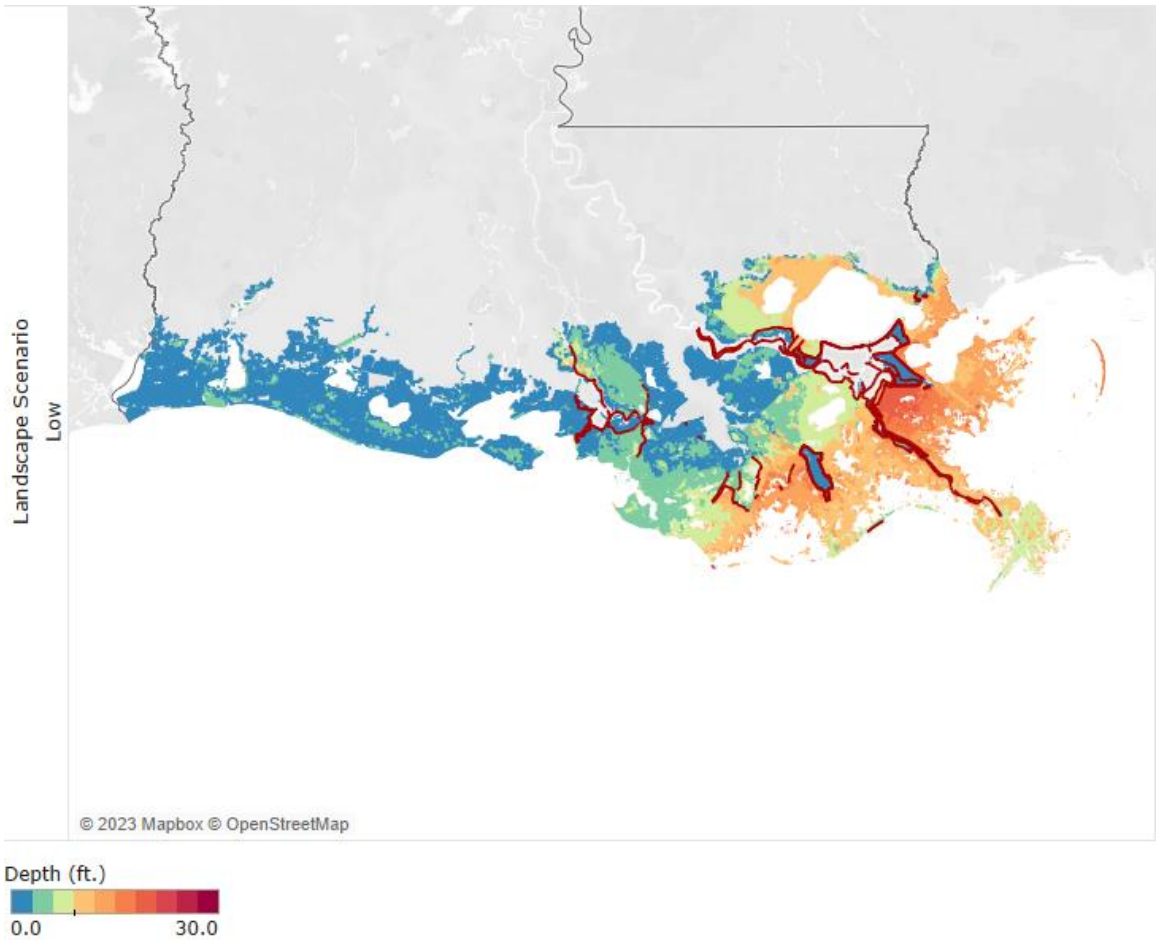

Figure 22. Maximum flood depth for Storm 276 with current levee alignments (FWOA without coastal forests, Year 10, S07).

FWOA (YEAR 10) ECONOMIC DAMAGE

CLARA simulations for Storm 276 generally show that in FWOA, economic damages will result from the combination of flooding (both extent and depth) and the density of population and residential structures in the impacted areas. The greatest direct economic damage resulting from Storm 276 in Year 10 is expected to be concentrated along the north shore of Lake Pontchartrain, a densely developed combination of urban and suburban development that is part of the New Orleans–Metairie–Kenner metropolitan area. This includes the communities of Mandeville, Covington, Abita Springs, Madisonville, Pearl River, Lacombe, and Slidell (Figure 23). Other locations within the New Orleans–Metairie–Kenner metropolitan area, including New Orleans East and the communities of St. Bernard Parish are also expected to experience economic damages from Storm 276 in a FWOA, though slightly lower than those experienced in the North Shore communities.

Storm 276 is expected to result in economic damage throughout the Terrebonne Basin, including the densely populated areas of Terrebonne Parish around Houma and nearby communities such as Bayou Cane and Bayou Blue as well as along Bayou Lafourche outside of the Larose to Golden Meadow levee system. North of the Larose to Golden Meadow system, relatively high flood depths are expected in the northern reach of the Barataria Basin.

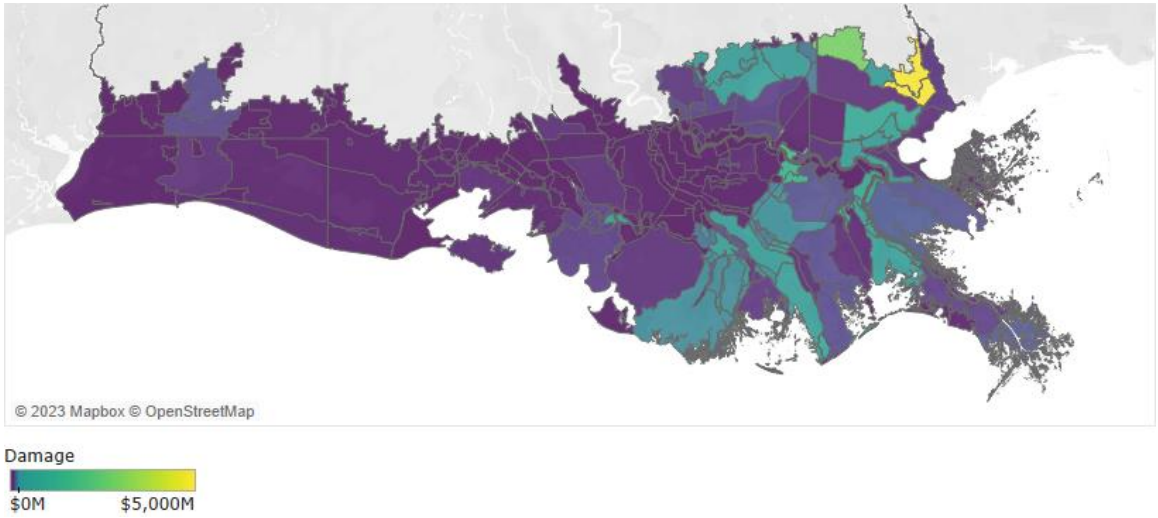

Figure 23. Economic damage for Storm 276 (FWOA, Year 10, S07).

FWOA WITHOUT COASTAL FORESTS (YEAR 10) ECONOMIC DAMAGE

CLARA simulations show that in Year 10 in a FWOA without coastal forests, few changes are observed in the damage surface, with a few notable exceptions. In the northern Barataria Basin between the Mississippi River and Bayou Lafourche the small fishing communities of Chackbay and Choctaw, located near Lac Des Allemands and the Lac Des Allemands Swamp, are expected to experience increased flood damage due to the removal of coastal forests. To the north of this area, at the western edge of the Pontchartrain Basin, Gonzales and Prairieville, two Ascension Parish suburbs of Baton Rouge, also see an increase in damages due to the removal of coastal forests. In both of these areas, however, the change in damage from Storm 276 in a FWOA with and without coastal forests is expected to be minimal (Figure 25).

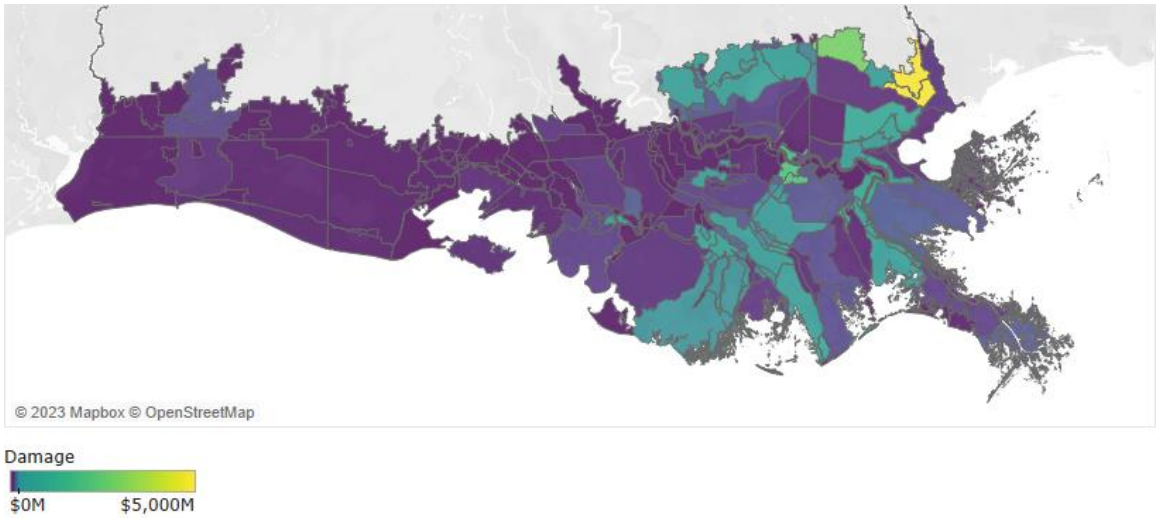

Figure 24. Economic damage for Storm 276 (FWOA without coastal forests, Year 10, S07).

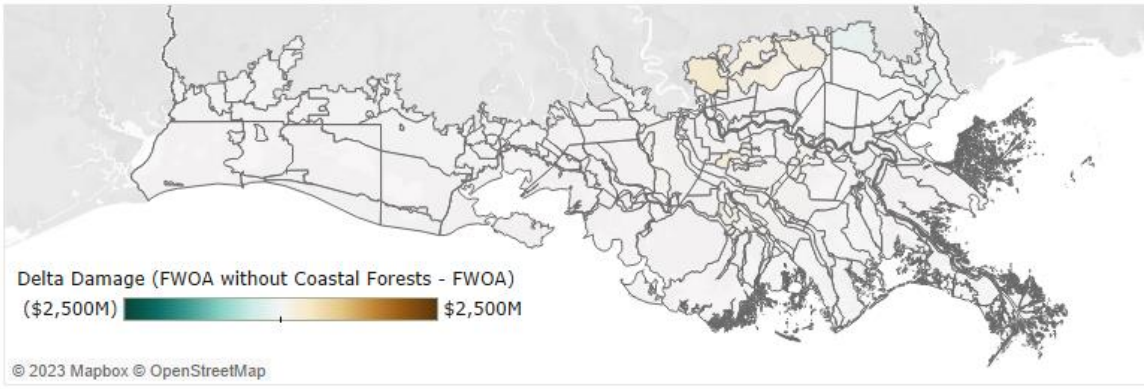

Figure 25. Change in economic damage between FWOA and FWOA without coastal forests for Storm 276 (Year 10, S07).

The expansion of the floodplain into the suburban, agricultural, and fishing communities of the northern Barataria Basin with the removal of coastal forests is expected to result in several communities that would not otherwise experience damage from Storm 276 suffering damage, including Chackbay, Choctaw, Gramercy/Lutcher, and South Vacherie (Table 2). In terms of the total flood damage resulting from Storm 276, damage amounts in these smaller communities are offset by those experienced in the more densely populated areas facing higher levels of flood exposure. Given their relatively high population levels and the projected increase in flooding, the communities of Gonzales and Prairieville are expected to experience the greatest total flood damage in a FWOA, with and without coastal forests.

Table 2. Communities expected to experience a 50% increase in flood damage from Storm 276 (FWOA and FWOA without coastal forests, Year 10, S07)

Community	Parish	FWOA Flood Damage (Year 10)	FWOA without Coastal Forests Flood Damage (Year 10)	Delta Damage % (FWOA without Coastal Forests - FWOA)
Choctaw	Lafourche	$0M	$22M	>1000%
Bayou Black	Terrebonne	$0M	$7M	>1000%
Gibson	Terrebonne	$0M	$19M	>1000%
Gramercy/Lutcher	St. James	$0M	$11M	>1000%
Chackbay	Lafourche	$9M	$299M	>1000%
Pierre Part	Assumption	$1M	$35M	>1000%
Bayou L'Ourse	Assumption	$0M	$5M	839%
Gonzales/Prairieville	Ascension	$60M	$477M	696%
South Vacherie	St. James	$45M	$229M	409%
Ponchatoula/Springfield	Tangipahoa	$24M	$105M	328%
Garyville	St. John the Baptist	$2M	$6M	250%
Kraemer	Lafourche	$24M	$44M	84%
Port Vincent/French Settlement	Livingston	$19M	$34M	77%
Gray	Terrebonne	$6M	$9M	50%

2.3 STORM 281

Synthetic Storm 281 is a tropical storm with a storm track heading of approximately 340 degrees, trending west of Bayou Lafourche and Caminada Headland (Figure 27). The storm passes along the eastern rim of Terrebonne Bay, crosses Lake Felicity and Lake Chien, before making landfall between the Terrebonne Parish communities of Isle de Jean Charles and Pointe Aux Chenes. The storm has a forward speed of 15.9 kts, reference pressure deficit of 98 mb, and radius to maximum winds of 36.6 mi. While Storm 281 is on the same track as Storm 276, Storm 281 is faster moving, more intense, and smaller in size.

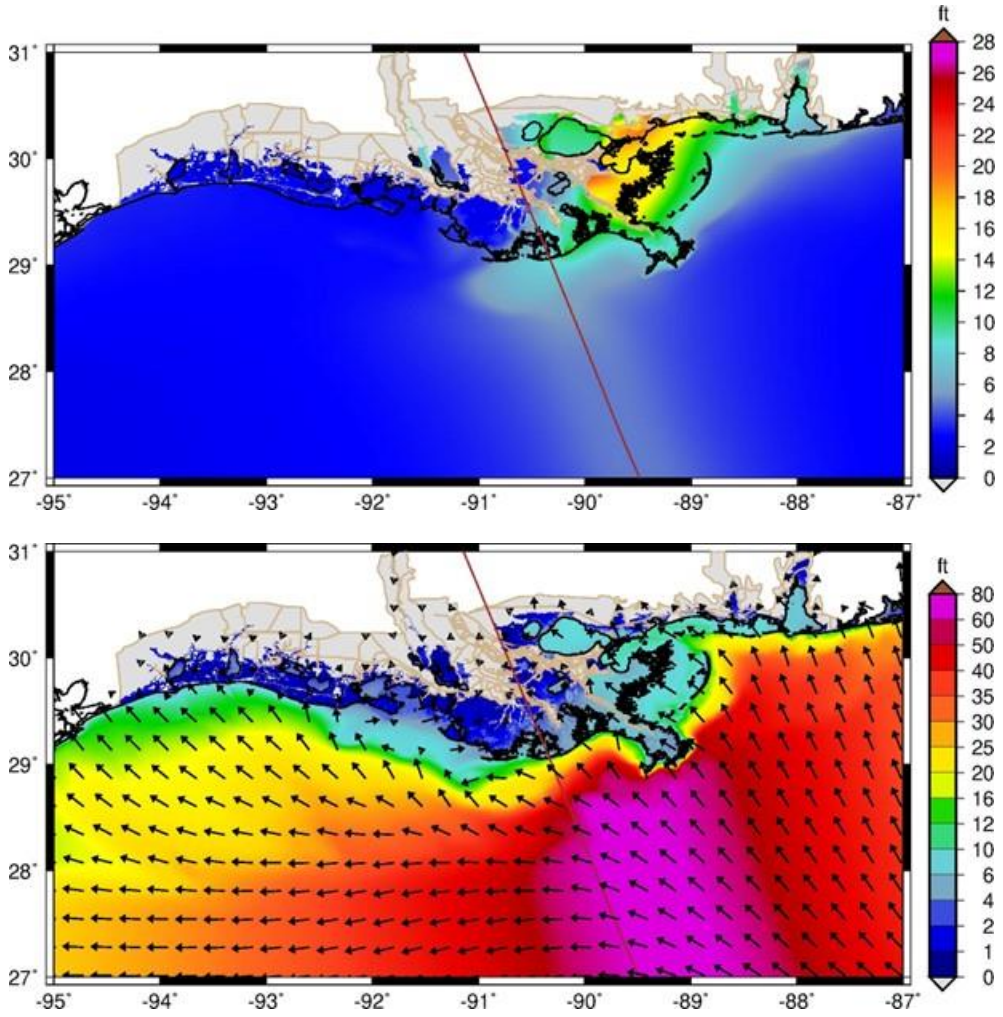

Figure 26. Track and heading for Storm 281 showing projected peak water surface elevation (top) and projected significant wave height (bottom) (FWOA, Year 10, S07).

SURGE AND WAVES

The ADCIRC+SWAN model was used to simulate storm surge and wave height for Storm 281 assuming a FWOA and a FWOA without coastal forests under S07 conditions. Results at Year 10 are presented below.

FWOA (YEAR 10)

At Year 10 under S07 conditions, ADCIRC+SWAN simulations show the anticipated surge would be greatest to the east of the storm track (Figure 27). While landfall would occur in the southcentral portion of Louisiana's coast along the eastern Terrebonne Bay near Isles de Jean Charles, simulations show that the highest predicted surge levels would occur in the upper Breton Sound Basin near the Carnarvon Freshwater Diversion and the community of Braithwaite at the junction of the HSDRRS levees in St. Bernard Parish and the Mississippi River levees, estimated to be between 20 and 22 ft (Figure 27). Simulations also show extremely high storm surge levels, ranging from 18 to 20 ft, along the Mississippi coast between the Pearl River and Waveland in Hancock County, and backwater up the Jourdan River, threatening the community of Diamondhead, Mississippi.

ADCIRC+SWAN simulations show several other locations predicted to experience notable surge heights from Storm 281 in a FWOA with coastal forests on the landscape. Areas within lower Breton Sound and Mississippi Sound, for example, are expected to see surge levels ranging from 16 to 18 ft, while levels in Lake Pontchartrain are predicted to reach as high as 10 ft. To the west of the Mississippi River Bird's Foot Delta, surge heights of 10 to 12 ft are projected for locations along Caminada Headland and along stretches of Highway 1 between Grande Isle and the southern terminus of the Larose to Golden Meadow levee system (Figure 27). On the west bank of the Mississippi River in Plaquemines Parish, surge heights are expected to reach 12 to 14 ft from Port Sulphur to Myrtle Grove. Surge heights are projected to lessen considerably with increasing distance from the river, diminishing to 6 to 8 ft in Barataria Bay.

Significant wave heights in the deep water in the Gulf of Mexico south of the modern Mississippi River Bird's Foot Delta are predicted to range anywhere from 60 to 80 ft from the Mississippi Canyon to the delta. The anticipated waves are generally directed northwest, east of the track following the wind speed direction as the storm approaches land (Figure 28). Wave heights remain high throughout Barataria Bight, around the delta, and to the east along the Chandeleur Islands and the Mississippi and Alabama barrier island system. Wave heights are predicted to vary from 20 to 35 ft depending on local water depth. To the west, significant wave heights are expected to attenuate along the central Louisiana coast before reaching the shoreline. Anticipated near-shore wave heights are greatest along the Caminada Headland where projected wave heights surpass 20 ft before rapidly breaking near the shores of the headland. Similar patterns of wave height amplification and breaking are observed along Breton Island and the Chandeleur Islands. Landward of the barrier islands throughout Barataria Bay, significant wave heights are lower in magnitude, and generally range from 6 to 10 ft. East of the delta, in lower Breton and Chandeleur sounds, as well as in the interior of Lake Borgne and Lake Pontchartrain, wave heights from Storm 281 are expected to reach 8 to 10 ft. Unlike the ADCIRC+SWAN simulation results for Barataria Bay, Terrebonne Bay wave heights are lower in

magnitude since the storm centerline tracks east of the Bay, with values ranging from 4 to 6 ft (Figure 28).

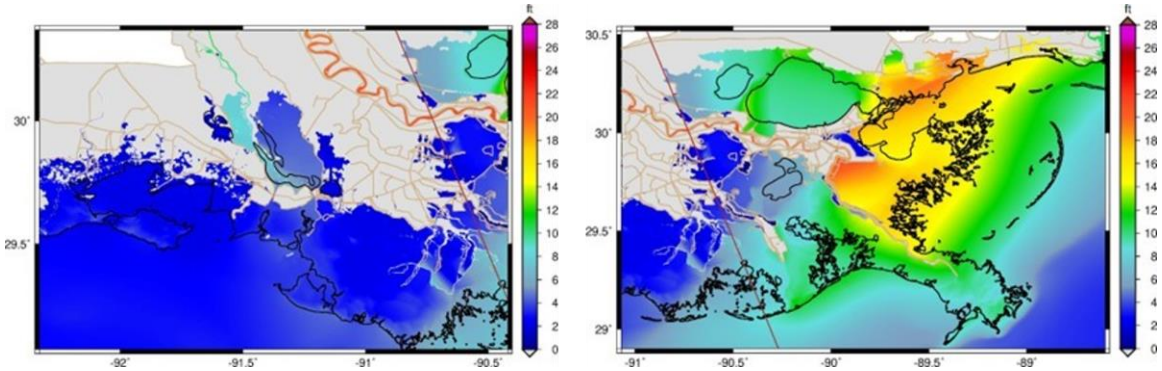

Figure 27. Peak water surface elevation (ft, NAVD88) along the southcentral (left) and southeast (right) Louisiana coast for Storm 281 (FWOA, Year 10, S07).

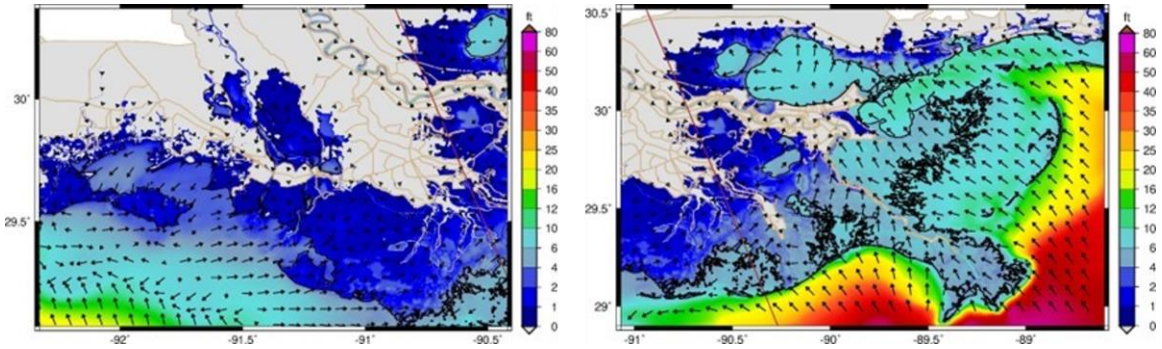

Figure 28. Significant wave heights (ft, NAVD88) along the southcentral (left) and southeast (right) Louisiana coast for Storm 281 (FWOA, Year 10, S07).

FWOA WITHOUT COASTAL FORESTS (YEAR 10)

Storm surge and wave simulations under a FWOA without coastal forests at Year 10 show storm surge heights and waves similar to those observed in a FWOA with coastal forests in place (Figure 27; Figure 28; Figure 29; Figure 30), with the exception of those areas proximate to where coastal forests were converted to marsh in the models. The lack of tree canopy and the lower resistance results in more surge moving inland and in some locations reducing surge height locally. For example, in the lower Pearl River Valley the removal of forests allows surge to move inland to the upper Pearl River Valley, thus surge heights in the lower valley are reduced by 0.25 to 0.75 ft. Similarly, along the western Lake Pontchartrain, the removal of coastal forests increased the surge heights inland in the Maurepas

Swamp. However, the increase of surge heights in Maurepas Swamp alleviated surge heights (0.25 to 0.75 ft) in western Lake Pontchartrain as now the forest did not pile up water along the Maurepas landbridge (Figure 30).

ADCIRC+SWAN results for Storm 281 in a FWOA without coastal forests show an increase in storm surge of 0.5 to 1 ft near Thibodaux/Lafourche Crossing/Bayou Country Club and from 0.25 to 0.5 ft in the upper Barataria Basin near the communities of Raceland in Lafourche Parish and Luling/Boutte in St. Charles Parish (Figure 29). Further to the north, surge height increases in the central Maurepas Swamp south of Lake Maurepas of the order of 0.5 ft to 0.75 ft and can reach more than 1.25 ft along the western and northern regions of the Maurepas Swamp, where the marsh abuts higher elevations allowing flood water to stack up. Similarly, backwater flooding caused by Storm 281 in the Pearl River allows surge levels to increase by nearly 2 ft (Figure 30).

Expected wave heights partly follow similar patterns as those observed for surge heights in a FWOA without coastal forests. Throughout the Maurepas Swamp and the Pearl River Valley, for example, wave heights are projected to increase by 1 to 2 ft as surge heights increase in the absence of coastal forests and the increase in local wind due lack of sheltering from the absence of a tree canopy, and the larger inundation from the increased surge helps generate and sustain larger waves respectively. ADCIRC+SWAN simulations show smaller wave height increases on the order of 0.25 to 0.5 ft along the perimeter of upper Barataria Basin near Raceland and Luling/Boutte (Figure 32).

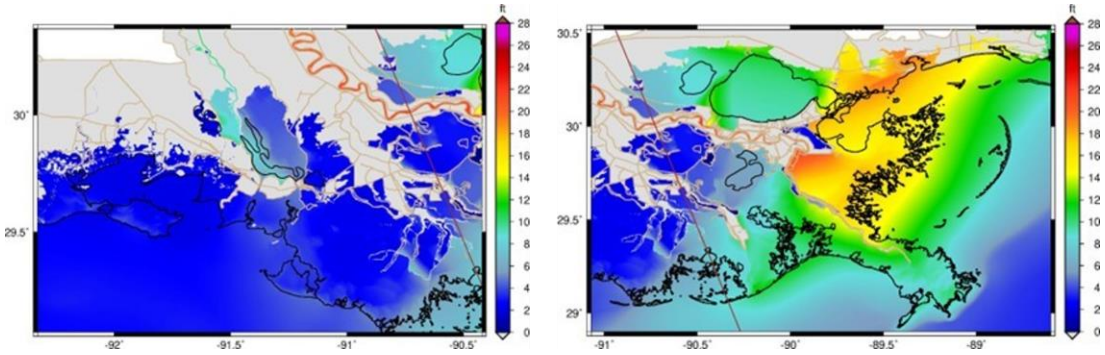

Figure 29. Peak water surface elevation (ft, NAVD88) along the southcentral (left) and southeast (right) Louisiana coast for Storm 281 (FWOA without coastal forests, Year 10, S07).

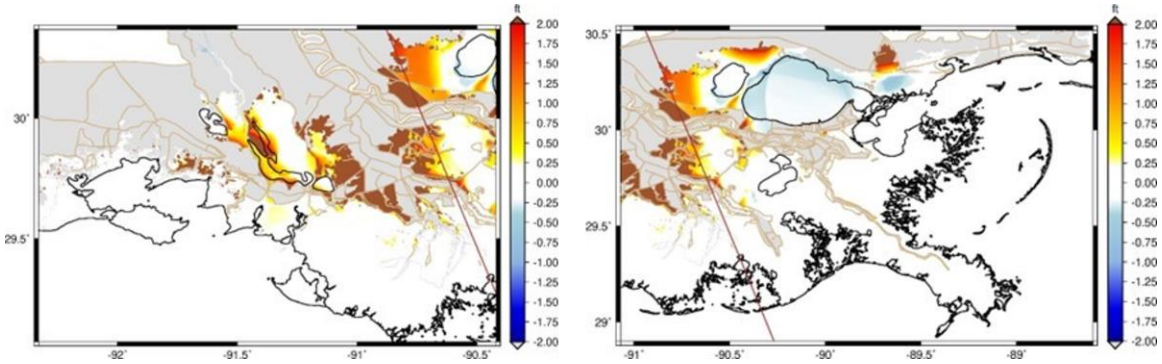

Figure 30. Change in peak water surface elevation (ft, NAVD88) along the southcentral (left) and southeast (right) Louisiana coast between FWOA and a FWOA without coastal forests for Storm 281 (Year 10, S07).

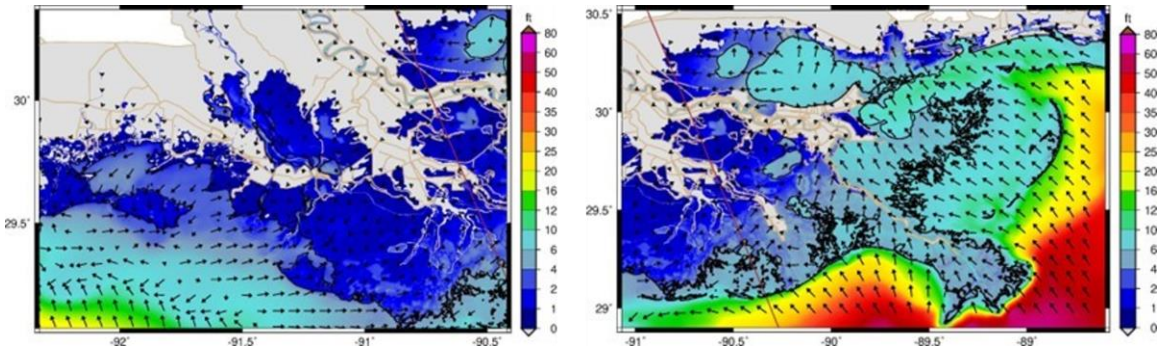

Figure 31. Significant wave heights (ft, NAVD88) along the southcentral (left) and southeast (right) Louisiana coast for Storm 281 (FWOA without coastal forests, Year 10, S07).

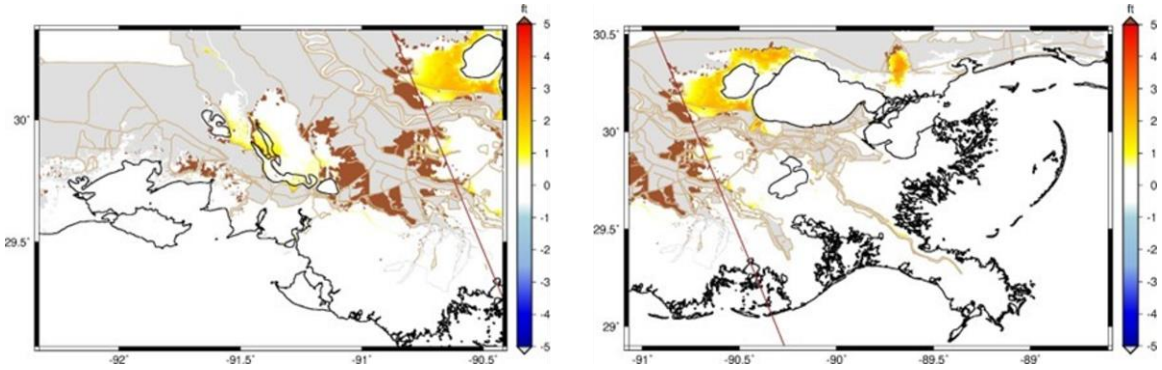

Figure 32. Change in significant wave height (ft, NAVD88) along the southcentral (left) and southeast (right) Louisiana coast between FWOA and FWOA without coastal forests for Storm 281 (Year 10, S07).

FLOOD DEPTH AND DAMAGE

The CLARA model was used to estimate flood depths and economic damage for Storm 281 assuming a FWOA and a FWOA without coastal forests under S07 conditions. Results for Year 10 are presented below.

FWOA (YEAR 10) FLOOD DEPTH

CLARA results show that the maximum flood depths from Storm 281 are expected to exceed 20 ft across the Breton Sound Basin in a FWOA with all coastal forests present (Figure 33). Flood depths are expected to approach 30 ft in the areas around the community of Braithwaite between the HSDRRS levees on the south side of St. Bernard Parish and the Mississippi River levees. Similarly high flood depths extend northward and westward into the Pontchartrain Basin, including areas around the Pearl River Wildlife Management Area and Big Branch Marsh National Wildlife Refuge and into the Slidell/Eden Isle/Pearl River community. Slightly lower but still notable flood depths are found in the Terrebonne and Barataria basins between the center line of the storm and the Mississippi River. The extent of this flooding is largely confined to the lower portions of these basins, generally south of the GIWW. To the west of the storm track, isolated areas of low-level flooding are observed, particularly on the southern shores of the large tidally influenced lakes of the region as well as in areas adjacent to the chenier ridges of southwest Louisiana.

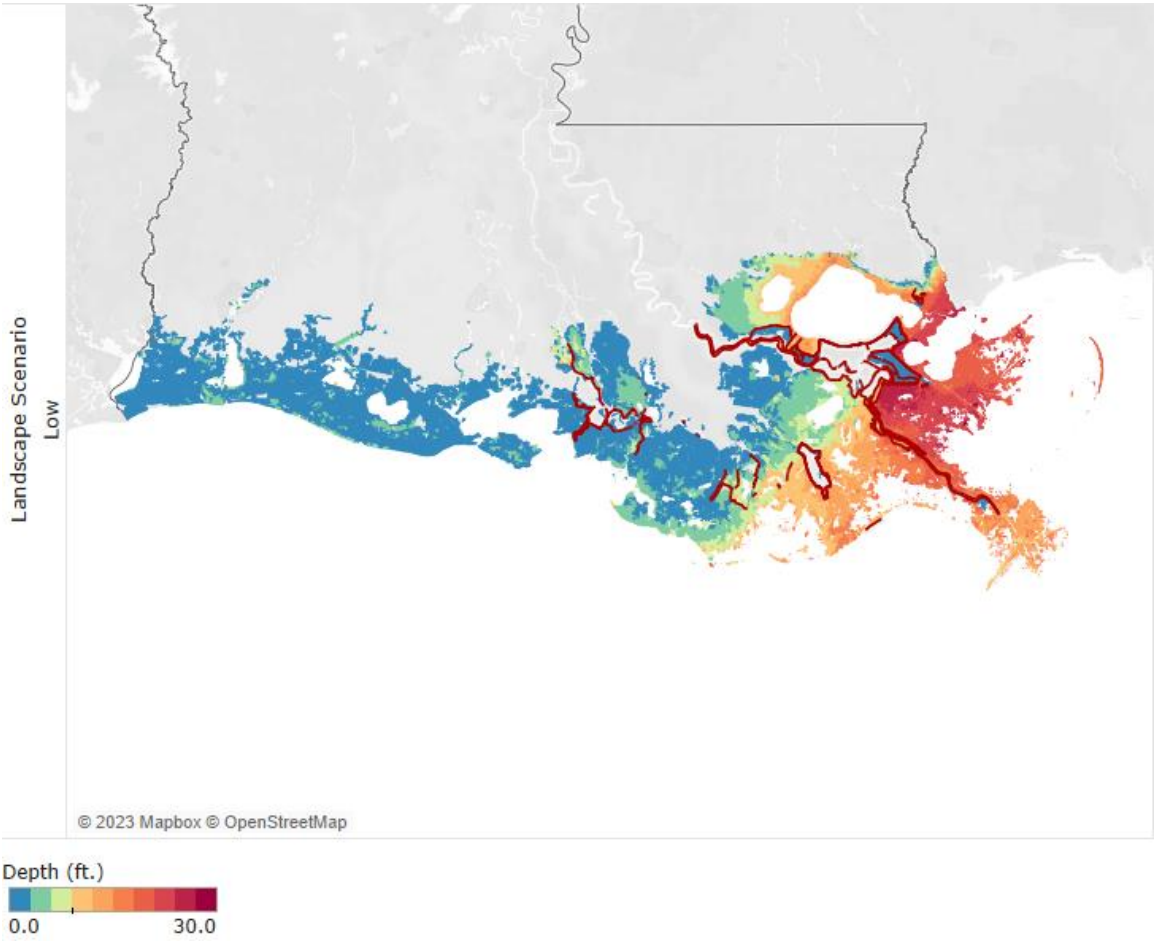

Figure 33. Maximum flood depth for Storm 281 with current levee alignments (FWOA, Year 10, S07).

FWOA WITHOUT COASTAL FORESTS (YEAR 10) FLOOD DEPTH

CLARA results show that the removal of coastal forests in a FWOA is not expected to notably alter either the extent of the floodplain or the flood depths resulting from Storm 281 relative to a FWOA with the coastal forests in place (Figure 34) aside from the examples discussed below. A slight expansion of the floodplain is expected to occur in the area west of Lac Des Allemands within the Lac Des Allemands Swamp. Increased flood depths are expected around the shores of Lake Maurepas, particularly on the western and southern shore. Slightly increased flood depths are observed within the Atchafalaya River levee system to the west of the storm track while very little change is expected to the projected flooding in the Chenier Plain.

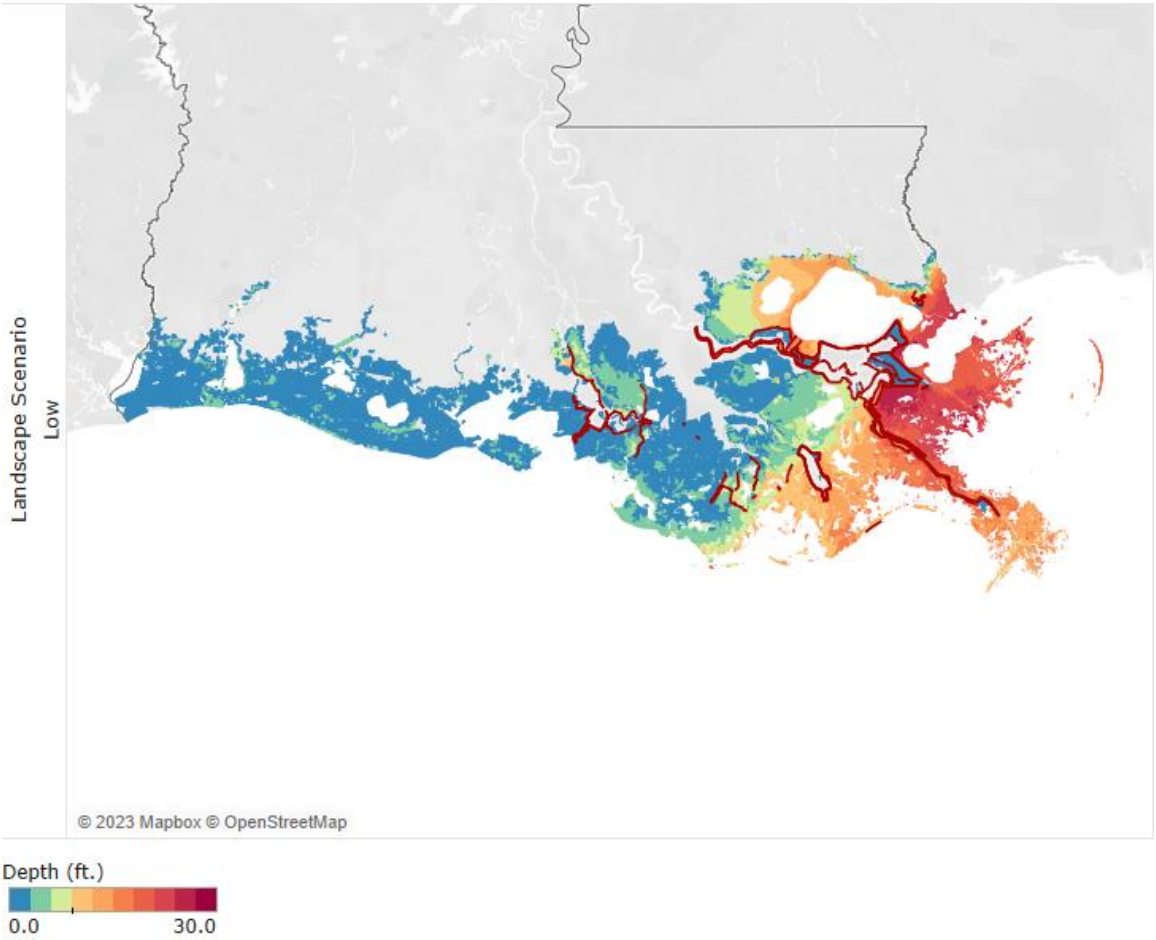

Figure 34. Maximum flood depth for Storm 281 with current levee alignments (FWOA without coastal forests, Year 10, S07).

FWOA (YEAR 10) ECONOMIC DAMAGE

In a FWOA with all coastal forests on the landscape, model results show that the highest levels of economic damage resulting from Storm 281 will be found in the Slidell/Eden Isle/Pearl River community, part of the New Orleans–Metairie–Kenner metropolitan area, with value expected to exceed $9 billion. This high level of economic damage is the result of the high population density of the community combined with one of the highest levels of flooding observed in the CLARA results for Storm 281. Elevated damage values are observed in the model from Slidell/Eden Isle/Pearl River, across the North Shore, and to the River Parishes, with localized high damage values expected in Mandeville/Covington/Madisonville/Abita Springs, also part of the New Orleans–Metairie–Kenner metropolitan area. Other locations within the eastern half of the metropolitan area, including New Orleans East and the urbanized portions of St. Bernard and Plaquemines parishes are also expected

to experience elevated economic damage from Storm 281. Beyond the North Shore and the New Orleans–Metairie–Kenner metropolitan area, CLARA results show that the communities surrounding Terrebonne Bay (in both Lafourche and Terrebonne parishes) will see notable levels of economic damage from this storm.

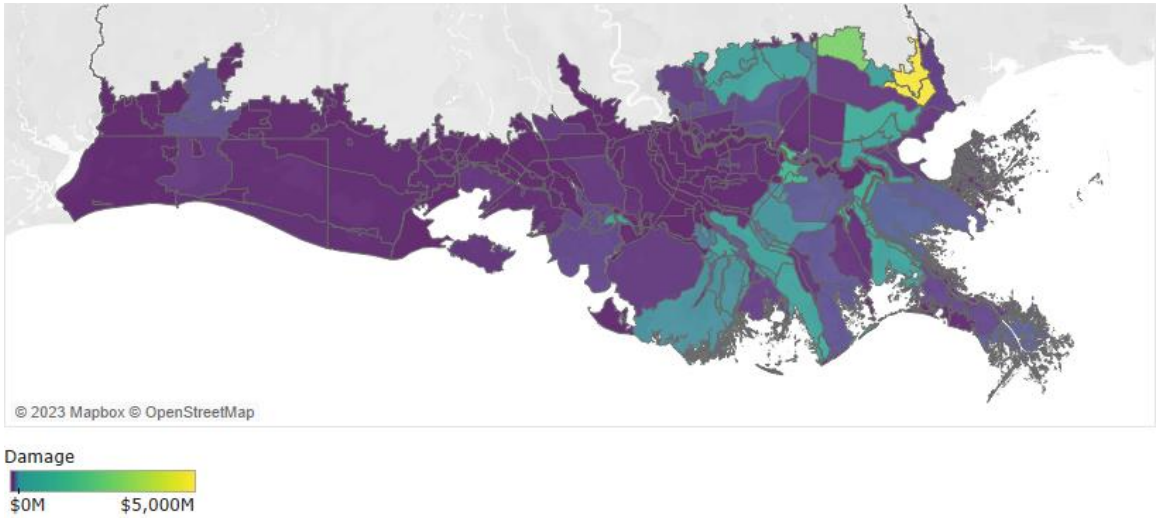

Figure 35. Economic damage for Storm 281 (FWOA, Year 10, S07).

FWOA WITHOUT COASTAL FORESTS (YEAR 10) ECONOMIC DAMAGE

CLARA simulations show that in Year 10 in a FWOA, few changes are observed in the damage surface between a landscape in which coastal forests are removed and one in which they remain (Figure 36). Several exceptions are discussed below. In the northern Barataria Basin between the Mississippi River and Bayou Lafourche, the small Lafourche Parish communities of Chackbay and Choctaw, located adjacent to the Lac Des Allemands Swamp, are expected to experience increased flood damage from Storm 281 without coastal forests in place. To the west of Lake Maurepas along the Mississippi River, the densely populated suburban communities of Gonzales and Prairieville are also expected to see an increase in damages due to the removal of coastal forests. Despite notable increases in damage for each of these two areas when coastal forests are removed, the overall change in damage from Storm 281 in a FWOA with and without coastal forests is expected to be minimal (Figure 37). This is due in large part to the lack of impact that removing coastal forests would likely have on the communities within the New Orleans–Metairie–Kenner metropolitan area, where the greatest anticipated damage would occur. CLARA results show, for example that there was a less than 1% difference between damages with and without coastal forests in both Slidell/Eden Isle/Pearl River and Mandeville/Covington/Madisonville/Abita Springs, which are the locations expected to experience the greatest damage from this storm.

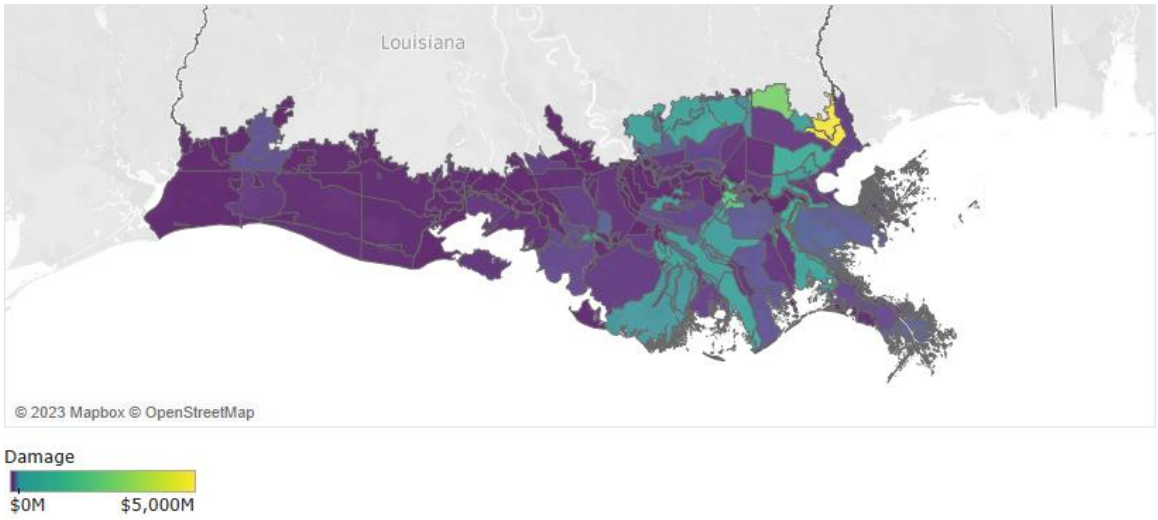

Figure 36. Economic damage for Storm 281 (FWOA without coastal forests, Year 10, S07).

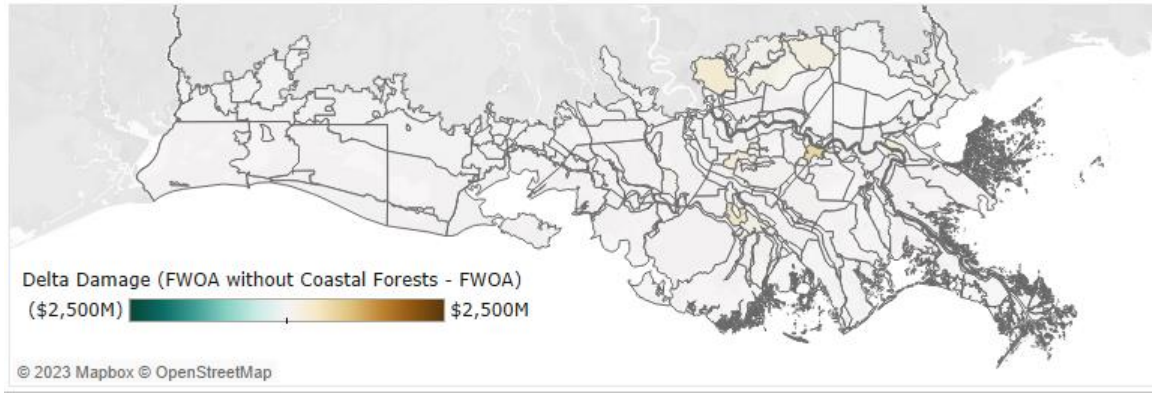

Figure 37. Change in economic damage between FWOA and FWOA without coastal forests for Storm 281 (Year 10, S07).

CLARA results show that the change in damage levels resulting from the removal of coastal forests are largely concentrated in the communities of the northern Barataria Basin between Bayou Lafourche and the Mississippi River including the River Parishes and the northern portions of both Lafourche and Terrebonne parishes (Table 3). Many of these communities, including Chackbay, Choctaw, and Gramercy/Lutcher, are in areas that did not flood with coastal forests on the landscape.

While most of the communities around Lake Pontchartrain are expected to experience significant damage from Storm 281, the removal of coastal forests is not expected to significantly alter damage levels, despite the high level of risk and high population densities of the region. Of the communities in

the New Orleans–Metairie–Kenner metropolitan area that are expected to be heavily impacted by Storm 281, only Chalmette/Arabi/Meraux in St. Bernard Parish are expected to be significantly damaged by the removal of coastal forests. Located within the HSDRRS system at the eastern edge of the levee system, this community is located at the edge of developed land and the coastal wetlands adjacent to Lake Borgne and the Breton and Chandeleur sounds. At the western end of the North Shore communities, Ponchatoula/Springfield, located in Tangipahoa Parish to the north of Lake Maurepas, is expected to experience a significant increase in damage in a FWOA without coastal forests. As with the communities in St. Bernard Parish, the location of Ponchatoula/Springfield proximate to coastal forests leaves it vulnerable to the impacts of forest removal.

Table 3. Communities expected to experience a 50% increase in flood damage from Storm 281 (FWOA and FWOA without coastal forests, Year 10, S07)

Community	Parish	FWOA Flood Damage (Year 10)	FWOA without Coastal Forests Flood Damage (Year 10)	Delta Damage % (FWOA without Coastal Forests - FWOA)
Chackbay	Lafourche	$0M	$320M	>1000%
Choctaw	Lafourche	$0M	$21M	>1000%
Bayou Black	Terrebonne	$0M	$3M	>1000%
Gramercy/Lutcher	St. James	$0M	$16M	>1000%
Gray	Terrebonne	$0M	$9M	>1000%
Pierre Part	Assumption	$0M	$7M	>1000%
Paradis	St. Charles	$3M	$90M	>1000%
Gonzales/Prairieville	Ascension	$33M	$418M	>1000%
South Vacherie	St. James	$32M	$335M	934%
Gibson	Terrebonne	$0M	$1M	807%
Raceland	Lafourche	$13M	$77M	494%
Bayou Cane	Terrebonne	$129M	$663M	413%
Kraemer	Lafourche	$13M	$56M	333%
Garyville	St. John the Baptist	$1M	$5M	318%
Ponchatoula/Springfield	Tangipahoa	$19M	$72M	275%
Amelia	St. Mary	$17M	$49M	194%
Bayou L'Ourse	Assumption	$2M	$4M	130%
Port Vincent/French Settlement	Livingston	$14M	$31M	127%
Bourg	Terrebonne	$73M	$153M	109%
Chalmette/Arabi/Meraux	St. Bernard	$385M	$687M	78%
Bayou Blue	Terrebonne	$62M	$101M	64%
Luling/Boutte	St. Charles	$1,298M	$2,093M	61%

2.4 STORM 388

Synthetic Storm 388 is a tropical storm with a track heading of approximately north (360 degrees), trending across Point Au Fer Island towards Fourleague Bay, west of the Isles Dernieres barrier island chain, making landfall in the center of Point Au Fer Island (Figure 38). The storm has a forward speed of 10.2 kts, reference pressure deficit of 68 mb, and radius to maximum winds of 46.5 mi. Storm 388 is the same size and has the same speed as Storm 276 but is slightly more intense.

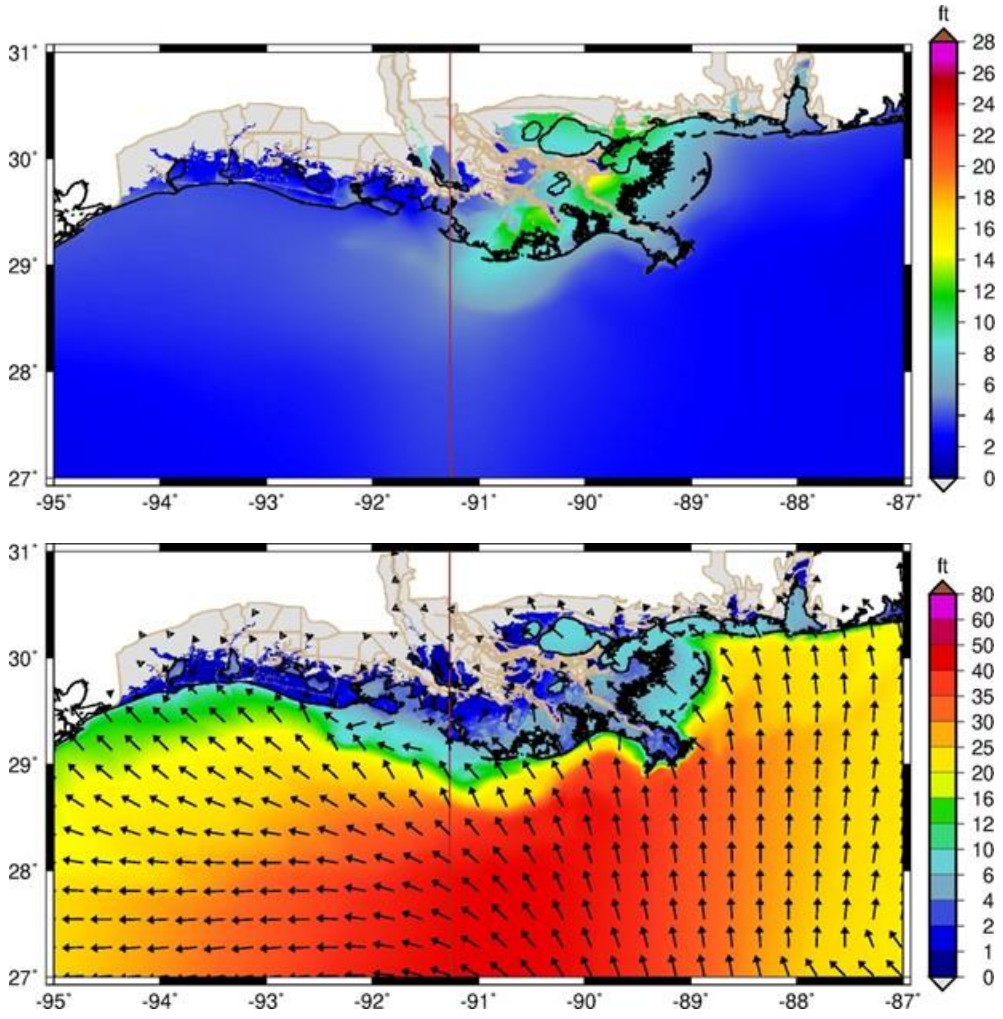

Figure 38. Track and heading for Storm 388 showing projected peak water surface elevation (top) and projected significant wave height (bottom) (FWOA, Year 10, S07).

SURGE AND WAVES

The ADCIRC+SWAN model was used to simulate storm surge and wave height for Storm 388 assuming a FWOA and a FWOA without coastal forests under S07 conditions. Results at Year 10 are presented below.

FWOA (YEAR 10)

At Year 10 under S07 conditions, ADCIRC+SWAN simulations show that Storm 388 would result in the greatest anticipated surge to the east of the storm track (Figure 39). While landfall would occur in the southcentral portion of Louisiana's coast near Fourleague Bay and the eastern Atchafalaya Bay, simulations show that the highest surge levels would occur in two locations to the east of the storm. Surge heights in the upper Breton Sound Basin near the Carnarvon Freshwater Diversion are predicted to reach an estimated 14 to 16 ft between Lake Borgne and the Mississippi River, an area that includes St. Bernard Parish and the portion of Plaquemines Parish located on the east bank of the Mississippi River. The northeastern section of Terrebonne Bay west of Cut Off/Galliano/Golden Meadow is expected to experience surge heights of the order of 12 to 14 ft from Storm 388 in a FWOA (Figure 39).

Storm surge heights ranging from 10 to 12 ft are predicted from Lake Borgne to central Breton Sound Basin reaching as far west as the north shore of Lake Pontchartrain and as far east as the Mississippi communities of Waveland and Bay St. Louis. ADCIRC+SWAN simulations show similar magnitude surge heights along the eastern Barataria Basin, west of the Mississippi River, spanning an area from Grand Bayou to east Lake Salvador near Lafitte/Jean Lafitte/Barataria (Figure 39). Storm surge remains high further to the west with predicted levels ranging from 10 to 12 ft throughout most of the northern Terrebonne Bay and surrounding communities, including Dulac, Dularge, Chauvin, Cocodrie, and Montegut (Figure 39).

Significant wave heights in the deep water of Barataria Bight and offshore of the modern Mississippi River Bird's Foot Delta are predicted to reach levels ranging from 40 to 50 ft, directed towards the north, following the wind speed direction as the storm approaches land (Figure 40). ADCIRC+SWAN results show that significant wave heights attenuate along the central Louisiana coast before reaching the shoreline. Simulated wave heights are highest along the Caminada Headland, reaching levels greater than 20 ft before rapidly breaking near the shores of the headland. To the east, from the edge of Barataria Bight to Sandy Point, wave heights vary from more than 20 ft offshore to less than 6 ft near-shore. The distance over which waves transform varies proportionally to the distance from Caminada Headland, emphasizing the role of the shoreface on dissipating waves. Similar wave height patterns are observed along the areas fronting all the barrier island systems from Isles Dernieres and

Timbalier barriers on the west to Breton and Chandeleur Islands on the east, with wave heights ranging between 6 to 10 ft (Figure 40).

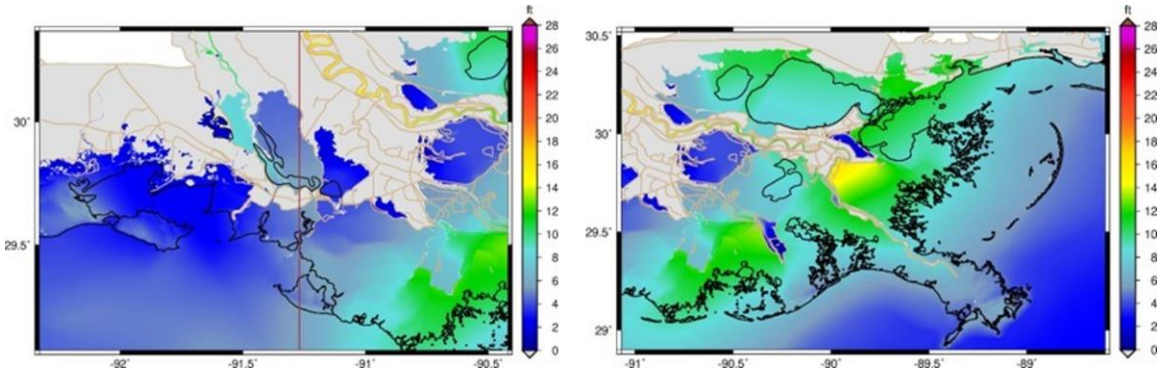

Figure 39. Peak water surface elevation (ft, NAVD88) along the southcentral (left) and southeast (right) Louisiana coast for Storm 388 (FWOA, Year 10, S07).

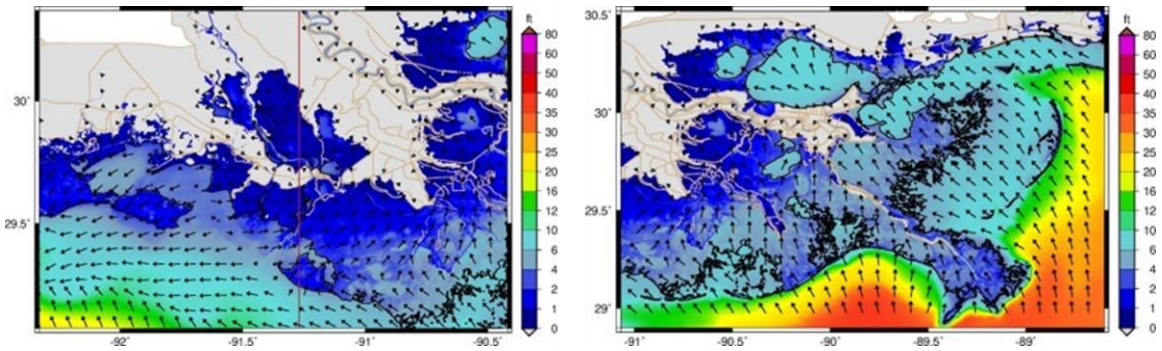

Figure 40. Significant wave heights (ft, NAVD88) along the southcentral (left) and southeast (right) Louisiana coast for Storm 388 (FWOA, Year 10, S07).

FWOA WITHOUT COASTAL FORESTS (YEAR 10)

Storm surge and wave simulations for Storm 388 in a FWOA without coastal forests at Year 10 reveal similar patterns to those observed in a FWOA with coastal forests on the landscape (Figure 39; Figure 40). Several exceptions are discussed below. As observed in other simulations described herein, the greatest amount of change in storm surge and wave heights is expected to occur in and inland of areas where coastal forests were converted to marsh in the models. The lack of tree canopy and the lower resistance results in more surge moving inland and, in some locations, reducing surge height locally. As observed with Storm 281, maximum surge levels in the lower Pearl River Valley and along the western and northern shores of Lake Pontchartrain are reduced by 0.5 to 0.75 ft in a FWOA

without coastal forests (Figure 42). Inland, an increase in storm surge on the order of 0.5 to 1 ft is projected near the communities of Raceland and Luling/Boutte, and approximately 1.5 ft near Thibodaux/Lafourche Crossing/Bayou Country Club (Figure 42).

ADCIRC+SWAN simulations show that surge levels decrease south of Lake Maurepas and along the Maurepas landbridge by approximately 0.75 to 1 ft. Conversely, surge levels to the west and to the north of Lake Maurepas are expected to increase on the order of 0.5 ft to 0.75 ft and reach more than 1.25 ft along the western and northern portions of Maurepas Swamp. In these areas, the marsh abuts higher elevations allowing surge water to stack up. In much the same way, backwater flooding in the Pearl River allows surge levels to increase by nearly 2 ft in the upper Pearl River Valley (Figure 42).

ADCIRC+SWAN results show that wave heights tend to follow many of the same patterns observed for storm surge with many local increases observed in the absence of coastal forests. In the northern reach of the Breton-Pontchartrain Region, two locations north of Lake Pontchartrain are expected to experience notable increases in wave height resulting from coastal forest removal. The first is located north of Lake Maurepas near Ponchatoula/Springfield in Tangipahoa Parish and the second is in the Pearl River Valley in St. Tammany Parish. In each of these locations, model results show wave heights increasing by 1 to 2 ft without coastal forests. Smaller increases ranging from 0.25 to 0.5 ft are expected to occur along the perimeter of upper Barataria Basin near the communities of Raceland, Thibodaux/Lafourche Crossing/Bayou Country Club, and Luling/Boutte (Figure 44).

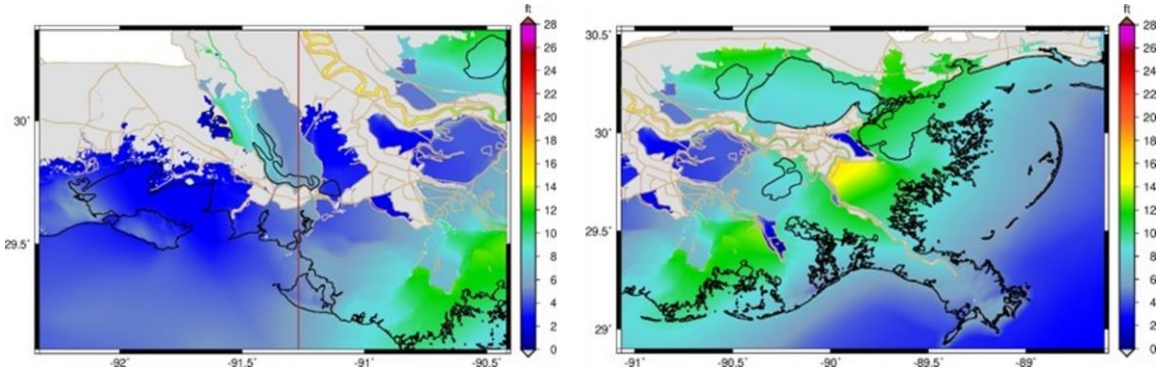

Figure 41. Peak water surface elevation (ft, NAVD88) along the southcentral (left) and southeast (right) Louisiana coast for Storm 388 (FWOA without coastal forests, Year 10, S07).

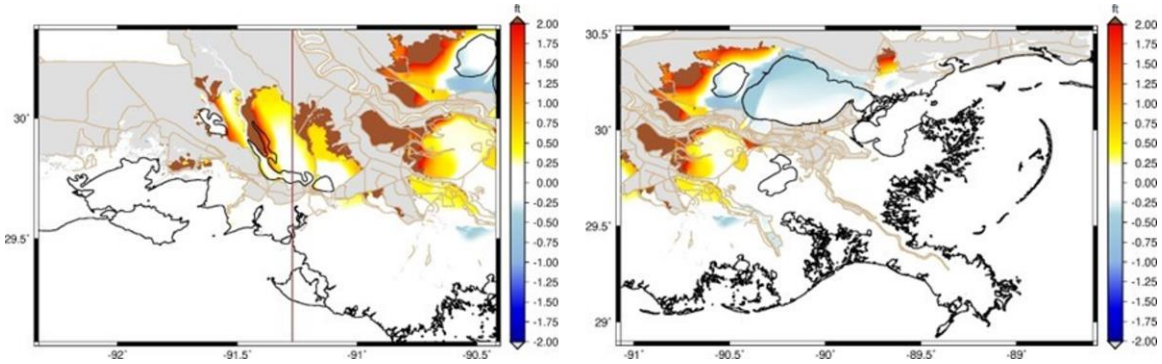

Figure 42. Change in peak water surface elevation (ft, NAVD88) along the southcentral (left) and southeast (right) Louisiana coast between FWOA and a FWOA without coastal forests for Storm 388 (Year 10, S07).

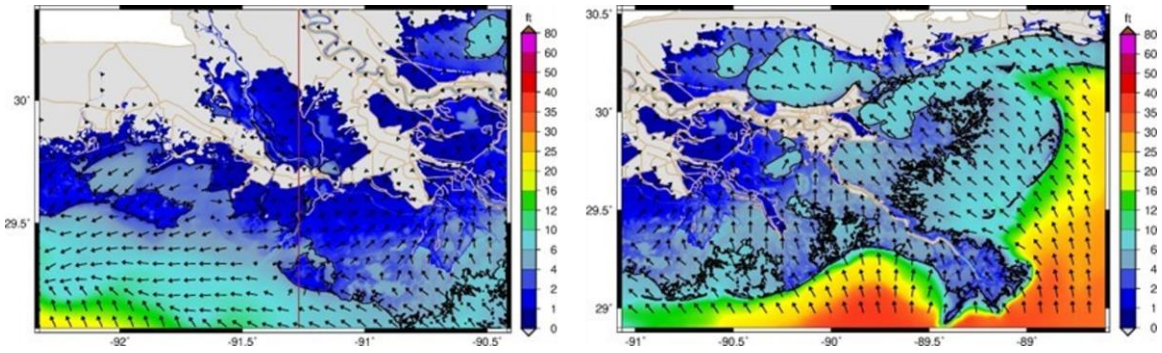

Figure 43. Significant wave heights (ft, NAVD88) along the southcentral (left) and southeast (right) Louisiana coast for Storm 388 in a FWOA without coastal forests (Year 10, S07).

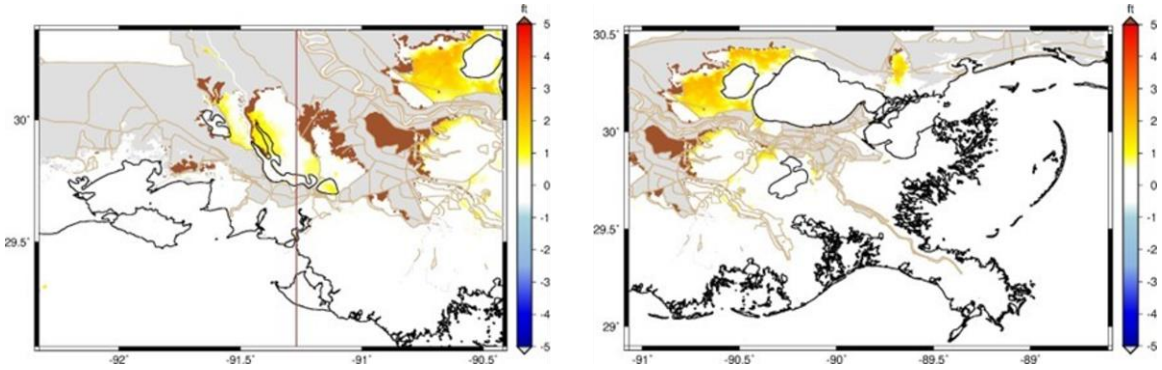

Figure 44. Change in significant wave height (ft, NAVD88) along the southcentral (left) and southeast (right) Louisiana coast between FWOA and FWOA without coastal forests for Storm 388 (Year 10, S07).

FLOOD DEPTH AND DAMAGE

The CLARA model was used to estimate flood depths and economic damage for Storm 388 assuming a FWOA and a FWOA without coastal forests under S07 conditions. Results for Year 10 are presented below.

FWOA (YEAR 10) FLOOD DEPTH

In a FWOA, CLARA simulations found that flood depths from Storm 388 are widespread across the coast, with the maximum flood depths expected to occur in two primary regions to the east of the storm center line where the counterclockwise circulation of the storm will push floodwater through the many sounds, lakes, and bays. While modeled flood depths are high in all southeast Louisiana coastal basins, the greatest local high values are found in the Pontchartrain/Breton and Terrebonne regions (Figure 45). Despite being geographically further away from the center line of the storm than locations in the Terrebonne Region, both the maximum water surface elevation derived from ADCIRC and the maximum flood depth values derived from CLARA are higher in the Pontchartrain/Breton Region, largely due to an amplification of water surface elevation levels between the HSDRRS levees and the Mississippi River levees in the Breton Sound Basin. As a result of this amplification, the location of maximum expected flooding is expected to be St. Bernard Parish where these levee features converge, an area that coincides with the highest expected water surface elevations found in the ADCIRC simulations.

Other locations expected to experience high levels of flooding include the coastal wetlands in the Terrebonne and Barataria basins south of the GIWW and in the marsh areas bounding Lake Pontchartrain's northern shore. Much of the landbridge separating lakes Pontchartrain and Maurepas is expected to flood as a result of Storm 388 in a FWOA, as is much of the land north of Lake Maurepas, an area comprised largely of two state Wildlife Management Areas (Joyce and Manchac). To the west of the storm track from Marsh Island across the Chenier Plain Region, expected flood depths from Storm 388 will extend inland, with the marshes and estuarine lakes of the regions allowing the storm surge and waves to penetrated further inland beyond the chenier ridges. While some communities atop the chenier ridges are not expected to experience any flooding, those located along the waterways and lakes of the region, such as Cameron and Hackberry, are expected to experience low level flooding from Storm 388 in a FWOA.

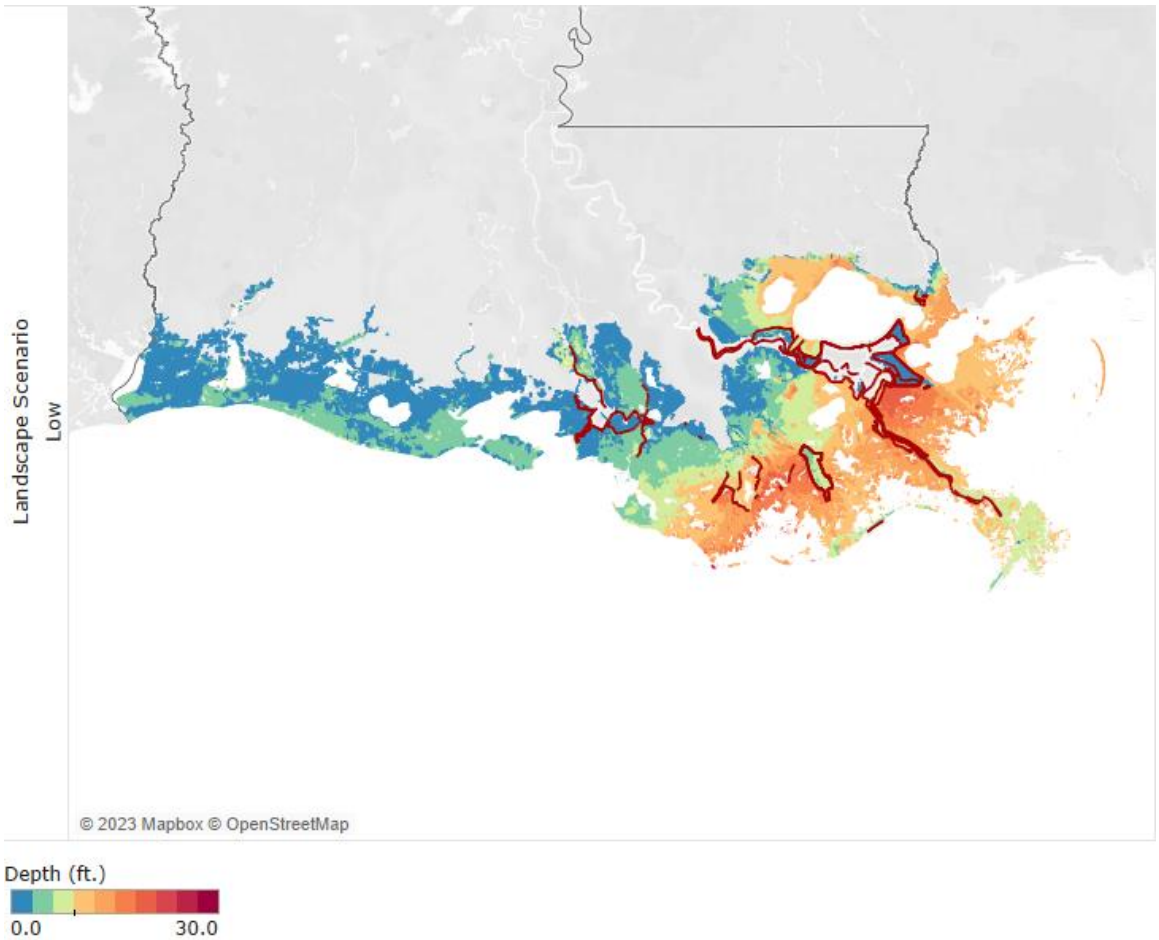

Figure 45. Maximum flood depth for Storm 388 with current levee alignments (FWOA, Year 10, S07).

FWOA WITHOUT COASTAL FORESTS (YEAR 10) FLOOD DEPTH

CLARA results for a FWOA without coastal forests for Storm 388 show an expansion of the floodplain in the Atchafalaya Basin and in the northern Barataria Basin between Bayou Lafourche and the Mississippi River (Figure 46). This includes the town of Pierre Part, a small fishing town located on both Lake Verret and the Atchafalaya River in a sparsely populated area along the eastern edge of the Atchafalaya Basin, as well as the small fisheries-dependent communities located around Lac Des Allemands and the Lac Des Allemands Swamp, including Chackbay, Choctaw, and South Vacherie. While the spatial extent of flooding is not expected to change in the area around Lake Maurepas, CLARA results do show an increase in flood depth in the area to the west of the lake crossed by the Amite and Blind rivers, including the small riverside communities of Port Vincent and French

Settlement. The removal of coastal forests is expected to have minimal to no impact on flood depths west of the storm track.

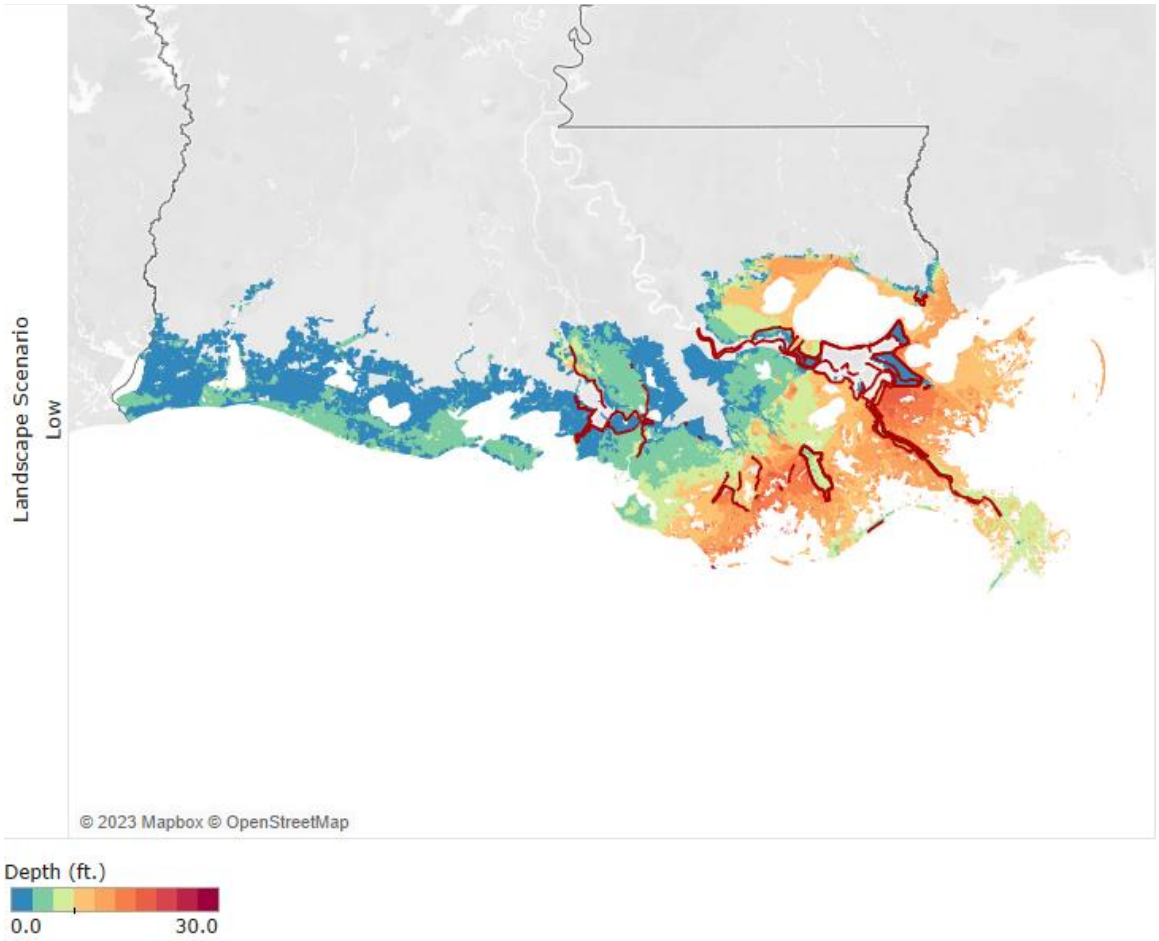

Figure 46. Maximum flood depth for Storm 388 with current levee alignments (FWOA without coastal forests, Year 10, S07).

FWOA (YEAR 10) ECONOMIC DAMAGE

CLARA simulations for Storm 388 follow the previously observed patterns where the distribution of economic damage is tied to locations with a high density of population and residential structures in addition to increased levels of flooding. The highest levels of economic damage are in three densely populated areas in southeast Louisiana: Houma, Cut Off/Galliano/Golden Meadow, and Slidell/Eden Isle/Pearl River (Figure 47). Expected economic damage values from Storm 388 in these communities

range from $5.8 to $7.7 billion. While the CLARA model results identified several regions expected to experience high damages from this storm, including the lower Terrebonne Region, the upper Barataria Region, and the Florida Parishes on the north shore of Lake Pontchartrain from the Pearl River to East Baton Rouge Parish, several locations with locally significant damage values were also identified, including the River Parish community of Luling/Boutte and the North Shore area comprised of Mandeville/Covington/Madisonville/Abita Springs.

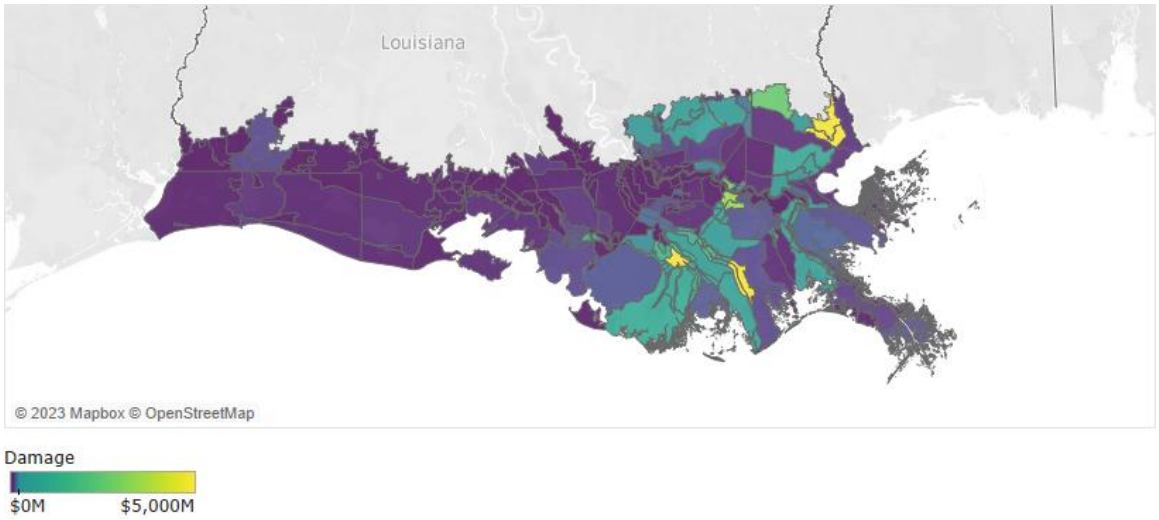

Figure 47. Economic damage for Storm 388 (FWOA, Year 10, S07).

FWOA WITHOUT COASTAL FORESTS (YEAR 10) ECONOMIC DAMAGE

Few observable differences in the overall damage patterns from Storm 388 in a FWOA are noted when coastal forests are removed from the landscape (Figure 48). The extent of the damaged area remains largely consistent as does the range of damage observed in each community aside from the example discussed below. An examination of the change in economic damage between a FWOA with and without coastal forests does reveal some moderately low increases in damage in several locations when coastal forests are removed (Figure 49). Notably, this includes locations in the Florida Parishes from just north of Lake Maurepas westward to Gonzales/Prairieville, as well as in Luling and Boutte, two census designated places located in St. Charles Parish that comprise a portion of the New Orleans–Metairie–Kenner metropolitan statistical area.

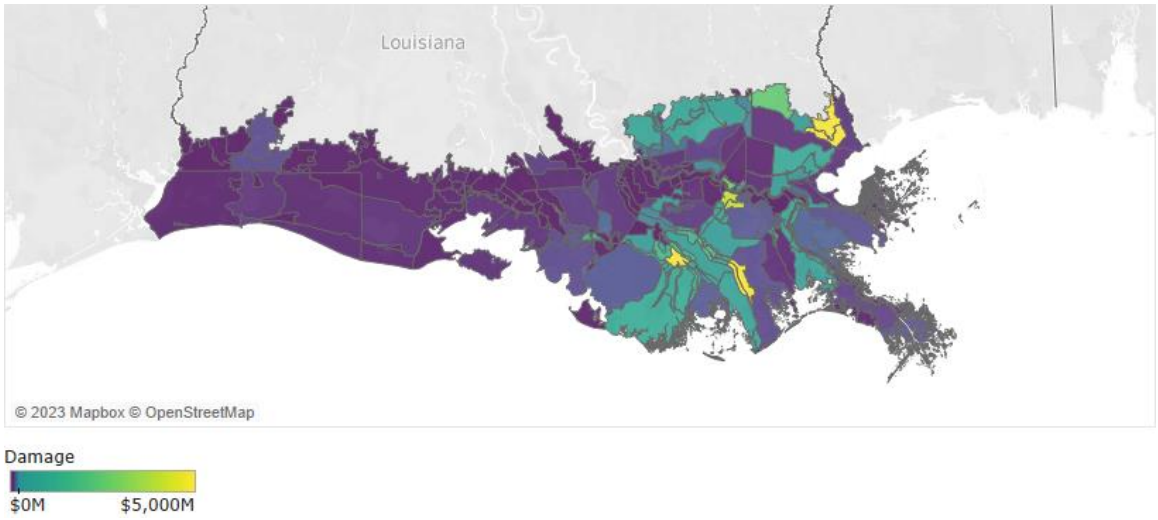

Figure 48. Economic damage for Storm 388 (FWOA without coastal forests, Year 10, S07).

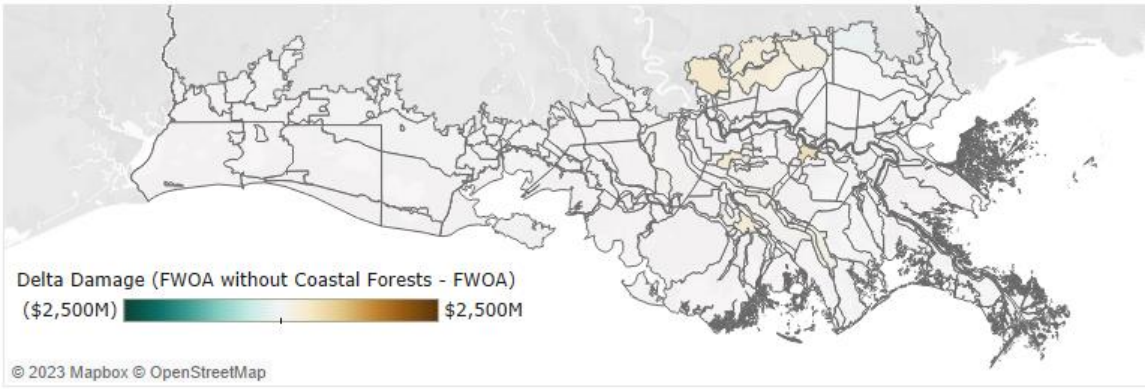

Figure 49. Change in economic damage between FWOA and FWOA without coastal forests for Storm 388 (Year 10, S07).

While CLARA results found the highest levels of economic damage from Storm 388 in densely populated communities such as Houma, Cut Off/Galliano/Golden Meadow, and Slidell/Eden Isle/Pearl River, very little difference in damage was observed when a FWOA without coastal forests was compared to a FWOA with coastal forests. In Houma, Cut Off/Galliano/Golden Meadow, and Slidell/Eden Isle/Pearl River — the three community groupings with the highest expected economic damages from Storm 388 — the impact of removing coastal forests is an increase in damage ranging from 0% to 5%. At the other end of the spectrum are smaller fishing communities located at the eastern edge of the Atchafalaya Basin and in the northern Barataria Basin between Bayou Lafourche and the Mississippi River, many of which are expected to see damage amounts increase by a factor of two or higher with the removal of coastal forests from the analysis (Table 4). Pierre Part, for example,

is located along the eastern edge of the Atchafalaya Basin and would be expected to see the damage from Storm 388 increase from $2 to $59 million in a FWOA without coastal forests. CLARA results show similar results for Choctaw, a small fishing community located near the Lac Des Allemands Swamp, which would see damage rise from $3 to $103 million in a FWOA without coastal forests. Further to the north, above Lake Maurepas, several communities are also expected to experience a large increase in damage with the removal of coastal forests from the analysis, including Ponchatoula/Springfield, Port Vincent/French Settlement, and Gonzales/Prairieville.

Table 4. Communities expected to experience a 50% increase in flood damage from Storm 388 (FWOA and FWOA without coastal forests, Year 10, S07)

Community	Parish	FWOA Food Damage (Year 10)	FWOA without Coastal Forests Flood Damage (Year 10)	Delta Damage % (FWOA without Coastal Forests – FWOA)
Hahnville	St. Charles	$0M	$7M	>1000%
Pierre Part	Assumption	$2M	$59M	>1000%
Choctaw	Lafourche	$3M	$103M	>1000%
Gramercy/Lutcher	St. James	$3M	$25M	843%
Ponchatoula/Springfield	Tangipahoa	$39M	$360M	823%
Chackbay	Lafourche	$71M	$436M	517%
Gonzales/Prairieville	Ascension	$215M	$673M	214%
South Vacherie	St. James	$103M	$264M	155%
Bayou Black	Terrebonne	$9M	$21M	131%
Killona/Taft	St. Charles	$2M	$5M	114%
Port Vincent/French Settlement	Livingston	$22M	$47M	113%

2.5 STORM 573

Synthetic Storm 573 is a tropical storm with a track heading of approximately northeast (40 degrees), trending across the east end of Marsh Island, in Atchafalaya Bay, making landfall near Bayou Teche National Wildlife Refuge in Franklin, Louisiana (Figure 50). The storm has a forward speed of 5.2 kts, reference pressure deficit of 88 mb, and radius to maximum winds of 28.1 mi. This is a slow moving storm, with an approach angle that is different from all other storms evaluated. Comparatively, it is only slightly less intense than Storm 281 and is the smallest in size compared to all other storms in this analysis.

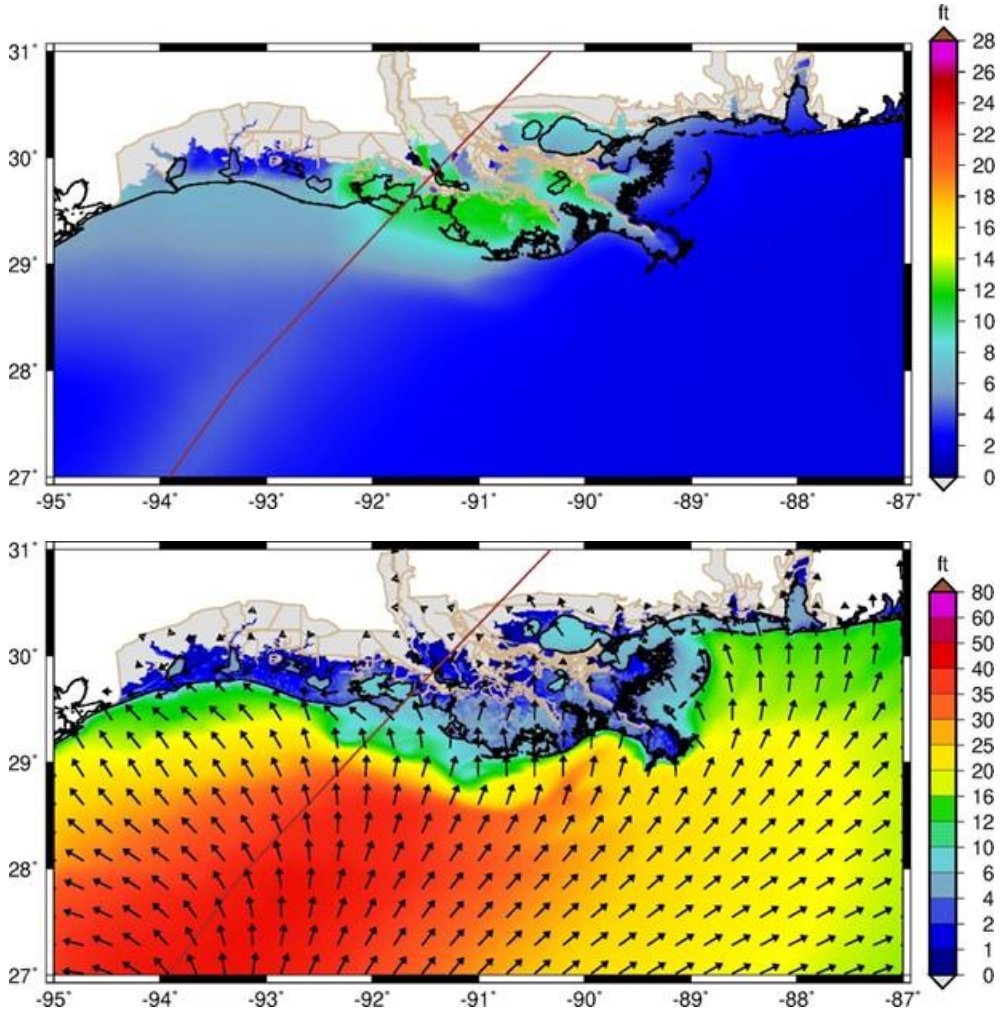

Figure 50. Track and heading for Storm 573 showing projected peak water surface elevation (top) and projected significant wave height (bottom) (FWOA, Year 10, S07).

SURGE AND WAVES

The ADCIRC+SWAN model was used to simulate storm surge and wave height for Storm 573 assuming a FWOA and a FWOA without coastal forests under S07 conditions. Results at Year 10 are presented below.

FWOA (YEAR 10)

At Year 10 under S07 conditions, ADCIRC+SWAN simulations show that if Storm 573 were to make landfall with coastal forests intact, the anticipated surge would be greatest to the east of the storm (Figure 51). However, given the storm track and that landfall is west of the Wax Lake Delta, significantly high surge levels are also evident to the west of the track. This is largely due to a lack of outlets for water to move out of the western Atchafalaya Bay and Vermilion Bay, which results in high surge levels west of the track. Unlike the other storms modeled as part of this analysis, the highest surge levels resulting from Storm 573 in a FWOA are not confined to a specific geographic area or region. Rather, a large region mostly east but also west of the storm track is anticipated to experience widespread inundation from the central coast to areas east of the Mississippi River Bird's Foot Delta (Figure 51). Model results show surge heights in the upper Breton Sound Basin reaching an estimated 10 to 12 ft with surge levels reducing sharply to 8 to 10 ft within a few miles south. High surge heights on the order of 9 to 11 ft are predicted to occur along the eastern Barataria Basin from Grand Bayou in Plaquemines Parish to Luling/Boutte in St. Charles Parish, including most of the west bank of the Mississippi River and extending westward along the GIWW (Figure 51). ADCIRC+SWAN results show high storm surge levels ranging from 8 to 10 ft in the Florida Parishes north of Lake Pontchartrain and Lake Maurepas from Ponchatoula/Springfield on the west to Mandeville/Covington/Madisonville/Abita Springs on the east. Surge levels of 10 to 12 ft are widespread from Morgan City/Berwick/Siracusaville to Houma, across the delta plain near the coast and throughout Atchafalaya Bay. In isolated locations immediately adjacent to levees and other high elevation locations, surge levels are shown to reach up to 14 ft.

The unique track of Storm 573 increases storm surge transmission inland between Morgan City/Berwick/Siracusaville and Thibodaux/Lafourche Crossing/Bayou Country Club, allowing surge heights to reach 10 ft within the Atchafalaya floodplain and the Attakapas Island Wildlife Management Area with water pilling up in St. Mary Parish north of Morgan City/Berwick/Siracusaville and Franklin (Figure 51). Lastly, west of the storm track, surge levels of 10 to 12 ft are predicted around West Cote Blanche Bay and Vermilion Bay, with surge levels infiltrating to New Iberia, Abbeville, and west toward White Lake (Figure 51).

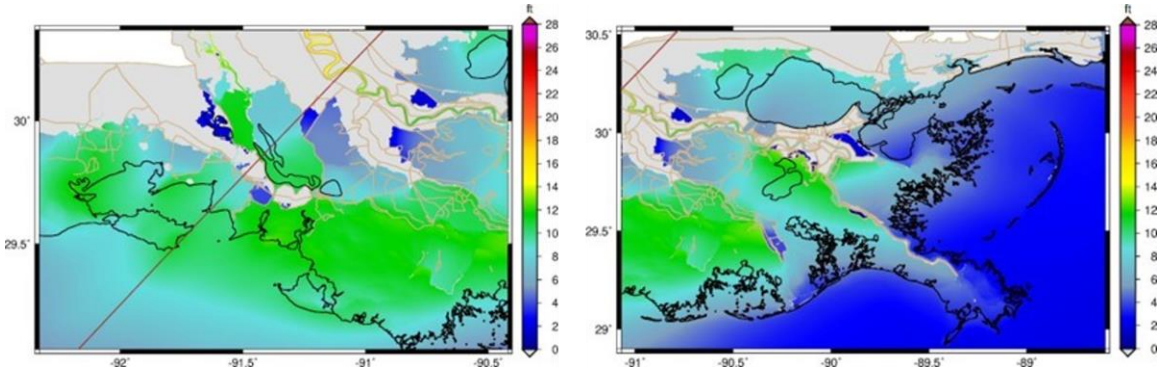

Figure 51. Peak water surface elevation (ft, NAVD88) along the southcentral (left) and southeast (right) Louisiana coast for Storm 573 (FWOA, Year 10, S07).

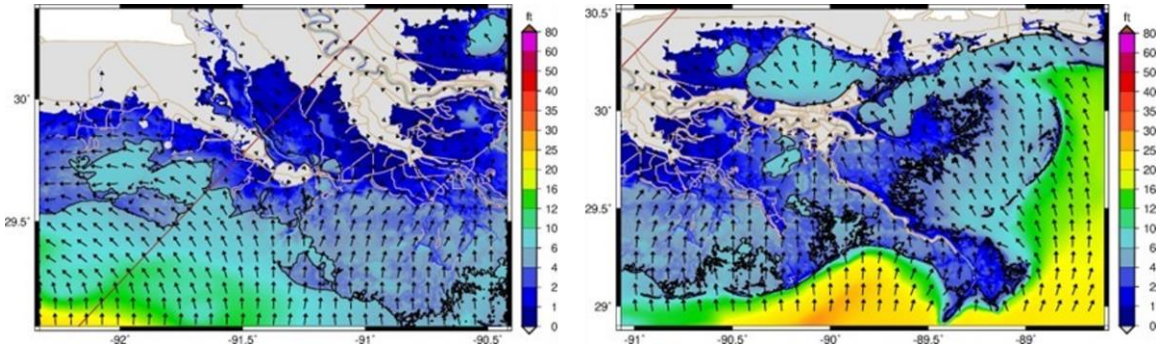

Figure 52. Significant wave heights (ft, NAVD88) along the southcentral (left) and southeast (right) Louisiana coast for Storm 573 (FWOA, Year 10, S07).

FWOA WITHOUT COASTAL FORESTS (YEAR 10)

Storm surge and wave simulations for Storm 573 under a FWOA without coastal forests at Year 10 are similar to those seen with coastal forests on the landscape (Figure 53; Figure 54; Figure 55; Figure 56). Like the other storms analyzed in a FWOA without coastal forests, Storm 573 produces maximum surge levels along the fringes of swamps and forested wetlands (e.g., Maurepas Swamp) and within river valleys due to backwater flooding effects (e.g., Pearl River). Other impacts of Storm 573 are seen along the eastern Barataria Basin and northeastern Terrebonne Basin, where water has the potential to pile up against levees or other elevated landscape features, such as ridges. Surge levels in the southern Maurepas Swamp and western Lake Pontchartrain are predicted to decrease by 0.75 to 1 ft in the absence of coastal forests, and subsequently cause an increase in surge levels by up to 2 ft in the western and northern Maurepas Swamp from Gonzales/Prairieville and Port Vincent/French Settlement to Ponchatoula/Springfield and Mandeville/Covington/Madisonville/ Abita Springs (Figure 54). Similarly, ADCIRC+SWAN results show that surge levels are expected to increase by up to 2 ft

along the upper Barataria Basin from Luling/Boutte to South Vacherie and approaching Napoleonville/Labadieville/Supreme. Conversely, in a FWOA, the removal of coastal forests may reduce surge levels from Storm 573 by nearly 1 ft south of the GIWW near Morgan City and north of the Larose to Golden Meadow levee system from Raceland to Larose (Figure 54). Finally, the model results show storm surge decreases of nearly 0.5 ft south of Highway 24 near Montegut and between Bourg and Larose. Conversely, increased surge levels of 0.5 to 0.75 ft are expected further north in an area of Terrebonne Parish stretching from Gray to Bourg, including Bayou Blue (Figure 54).

ADCIRC+SWAN results show increases in wave heights in the Florida Parishes north of lakes Maurepas and Pontchartrain from Gonzales/Prairieville and Ponchatoula/Springfield to Mandeville/Covington/Madisonville/Abita Springs. In these areas, model results show that wave heights are predicted to increase by 1 to 2 ft with local maximum wave heights exceeding 2 ft in locations abutting levees and other high elevation locations where the waves can pile up (Figure 56). Similar magnitude increases in wave heights are predicted to occur along the upper Barataria Basin from Luling/Boutte to South Vacherie and along the stretch of Highway 182 from Amelia to Houma. In the absence of coastal forests, the simulated storm surge from Storm 573 is funneled into the Atchafalaya Basin between Amelia and Houma, towards the Attakapas Island Wildlife Refuge. Model results show that wave heights in this area are expected to increase by nearly 2 ft across the floodplain in a FWOA with coastal forests removed (Figure 56).

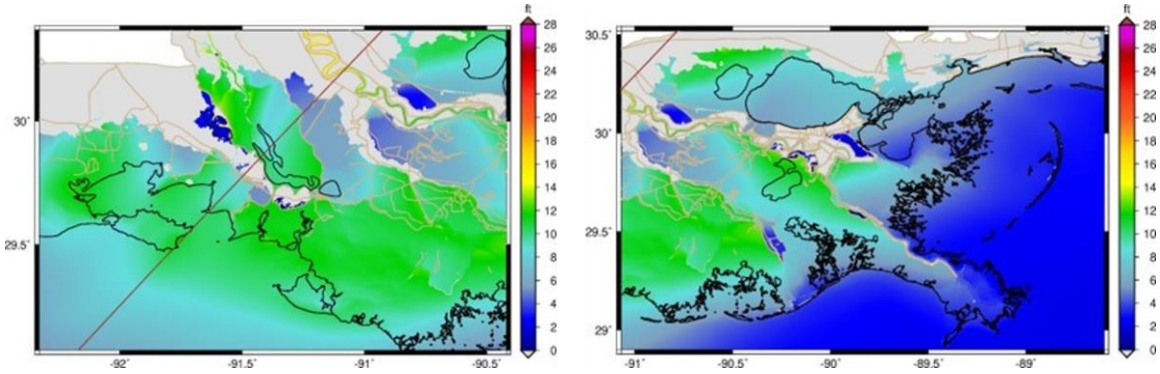

Figure 53. Peak water surface elevation (ft, NAVD88) along the southcentral (left) and southeast (right) Louisiana coast for Storm 573 (FWOA without coastal forests, Year 10, S07).

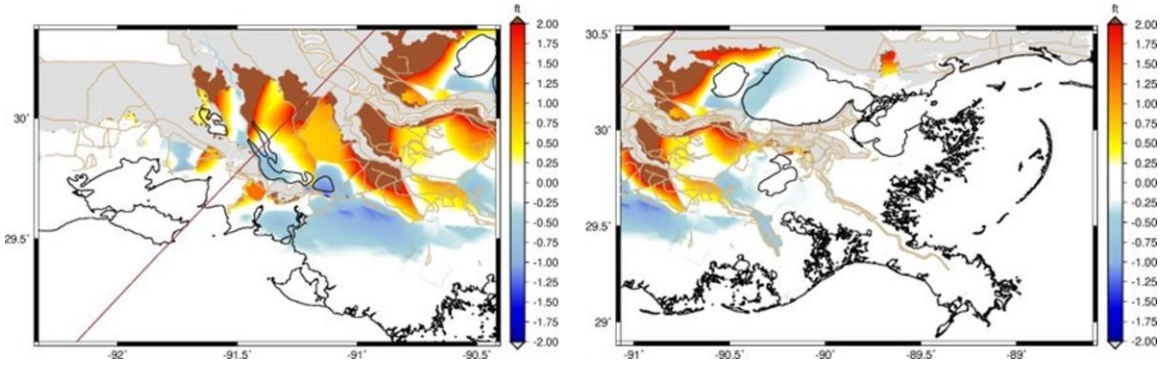

Figure 54. Change in peak water surface elevation (ft, NAVD88) along the southcentral (left) and southeast (right) Louisiana coast between FWOA and a FWOA without coastal forests for Storm 573 (Year 10, S07).

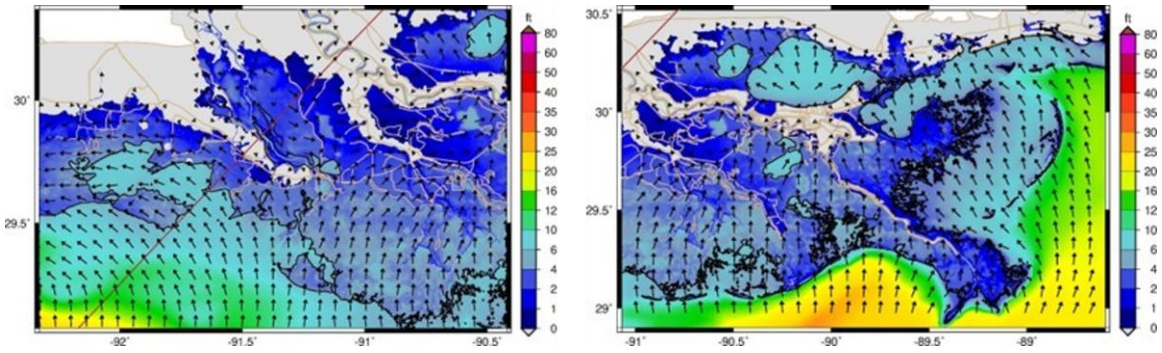

Figure 55. Significant wave heights (ft, NAVD88) along the southcentral (left) and southeast (right) Louisiana coast for Storm 573 (FWOA without coastal forests, Year 10, S07).

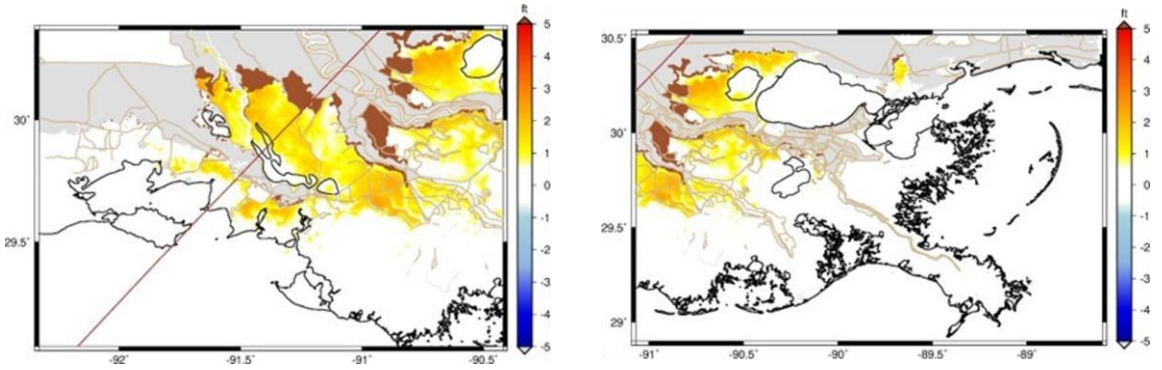

Figure 56. Change in significant wave height (ft, NAVD88) along the southcentral (left) and southeast (right) Louisiana coast between FWOA and FWOA without coastal forests for Storm 573 (Year 10, S07).

FLOOD DEPTH AND DAMAGE

The CLARA model was used to estimate flood depths and economic damage for Storm 573 assuming a FWOA and a FWOA without coastal forests under S07 conditions. Results for Year 10 are presented below.

FWOA (YEAR 10) FLOOD DEPTH

In a FWOA, CLARA simulations show that flood depths from Storm 573 are widespread across the coast, with extremely high flood depths extending from the eastern side of White Lake in Vermilion Parish to the Mississippi River in Plaquemines Parish with other local impacts in the Breton/Pontchartrain Region (Figure 57). With its northeasterly trajectory crossing both Marsh Island and the inland community of Franklin in St. Mary Parish, Storm 573 is expected to result in a far more dispersed flood surface and more inland flooding than the other storms analyzed. To the east of the storm track, high flood depths are predicted to extend into the northern portions of both the Terrebonne and Barataria regions, far north of the GIWW. The Mississippi River levees serve as a barrier preventing flood levels from increasing in many areas east of the river in the Breton/Pontchartrain Region. However, CLARA simulations predict increased flood risk on the west bank of the river, extending northward into the River Parishes. To the east of the Mississippi River, CLARA results show two areas of high flood depths, one in the Breton Sound Basin and the other in the Pontchartrain Basin. In the Breton Sound Basin, the highest modeled flood depth is likely to occur near Braithwaite where the HSDRRS levees on the south side of St. Bernard Parish and the Mississippi River levees converge. Notable flooding is also anticipated in the Pontchartrain Basin around lakes Pontchartrain and Maurepas, with the forested wetlands between these two lakes expected to experience an increase in flood depths.

To the west of the storm track, equally high flood levels are expected from Marsh Island to the western shore of Vermilion Bay, nearly reaching the shores of White Lake. From White Lake westward, flood depths are expected to be less than those on the eastern side of the storm but still several feet above baseline. Further, CLARA results show that the flooding from Storm 573 will extend inland beyond the marshes and estuarine lakes of the region, including Calcasieu Lake, Grand Lake, and White Lake. This flooding is expected to impact the communities sited along these lakes as well as many smaller communities located atop the chenier ridges in southern Cameron Parish.

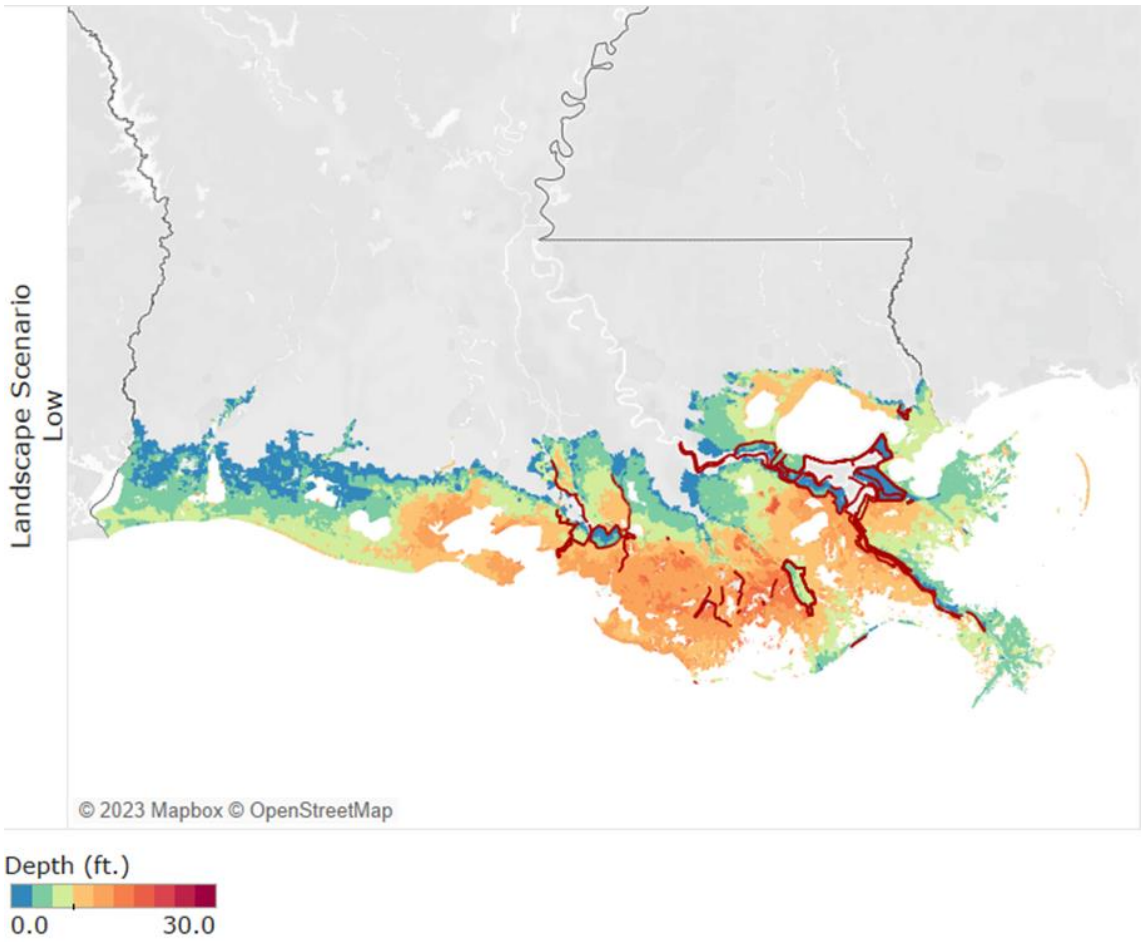

Figure 57.Maximum flood depth for Storm 573 with current levee alignments (FWOA, Year 10, S07).

FWOA WITHOUT COASTAL FORESTS (YEAR 10) FLOOD DEPTH

CLARA results for a FWOA without coastal forests for Storm 573 show little expansion of the floodplain although there are notable increases in flood depths in some areas (Figure 58). Most of the areas experiencing increased flood depths are immediately adjacent to major waterways. This includes an increase in flood depths in many communities located on the west bank of the Mississippi River, as far north as the River Parishes community of Edgard/North Vacherie/Wallace. Largely unpopulated areas within the Atchafalaya River levees north of Patterson and Morgan City/Berwick/Siracusaville are also expected to see an increase in flood depths for a FWOA without coastal forests for Storm 573. CLARA simulations also show flood depths increasing near Thibodaux/Lafourche Crossing/Bayou Country Club in Lafourche Parish. Finally, while the spatial extent of flooding is not expected to change in the

area around Lake Maurepas, CLARA results do show an increase in flood depth north of the lake near Ponchatoula/Springfield and west of the lake near the Amite and Blind rivers, including the small riverside communities of Port Vincent and French Settlement.

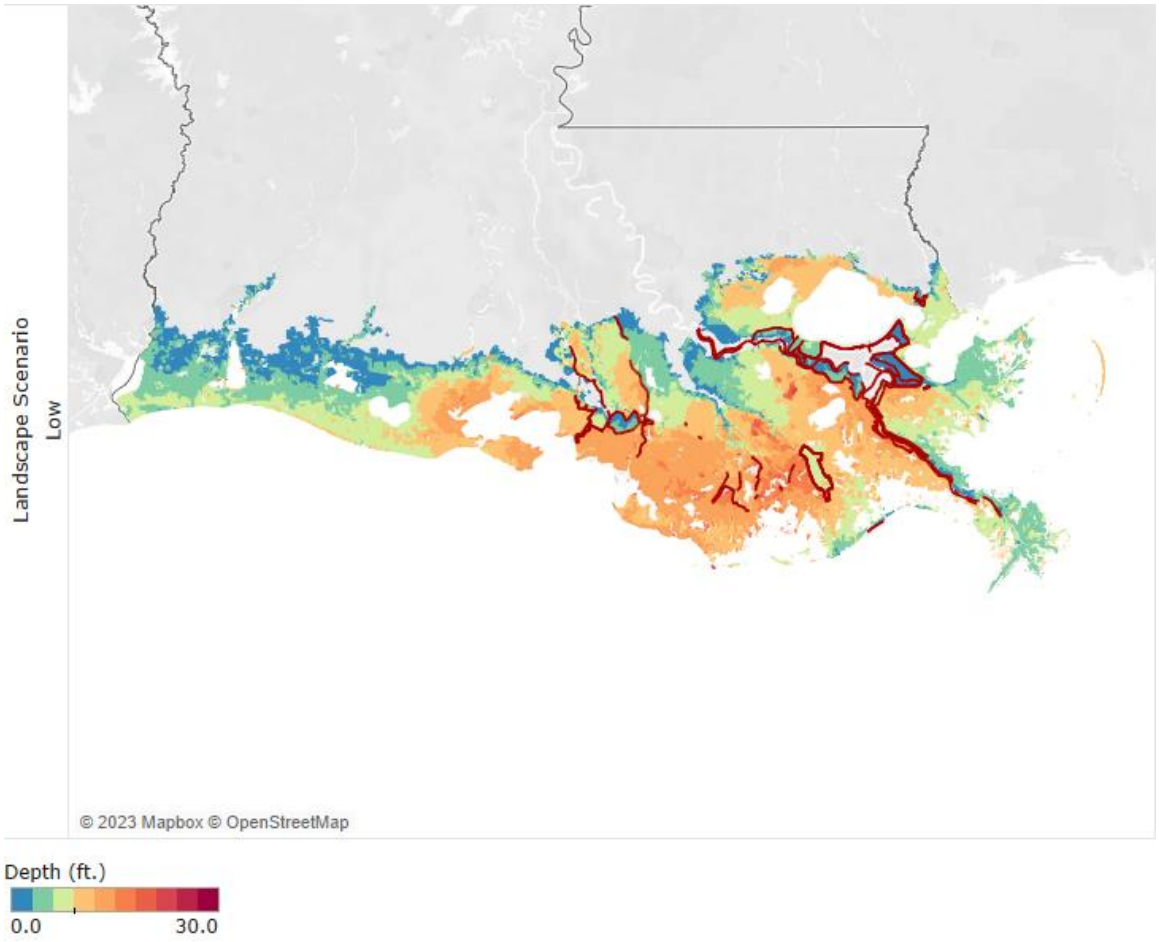

Figure 58. Maximum flood depth for Storm 573 with current levee alignments (FWOA without coastal forests, Year 10, S07).

FWOA (YEAR 10) ECONOMIC DAMAGE

As observed for other storm simulations herein, the damages resulting from Storm 573 are expected to be greatest in locations with a high density of population and residential structures. The highest levels of economic damage from Storm 573 in a FWOA are concentrated in seven densely populated community groups broadly distributed across the coastal zone, from the Central Coast Region to the

Breton/Pontchartrain Region; Morgan City/Berwick/Siracusaville in St. Mary Parish, Houma and Bayou Cane in Terrebonne Parish, Cut Off/Galliano/Golden Meadow in Lafourche Parish, Luling/Boutte in St. Charles Parish, the Westbank communities of Jefferson Parish, and the North Shore community of Slidell/Eden Isle/Pearl River in St. Tammany Parish (Figure 59). Expected damages from Storm 573 in FWOA in these communities range from $4.8 billion in Morgan City/Berwick/Siracusaville to $14.5 billion in the city of Houma. Beyond these densely populated communities with extremely high expected damage values, the damage surface resulting from Storm 573 is largely dispersed across the coastal zone, encompassing portions of all coastal regions in the state.

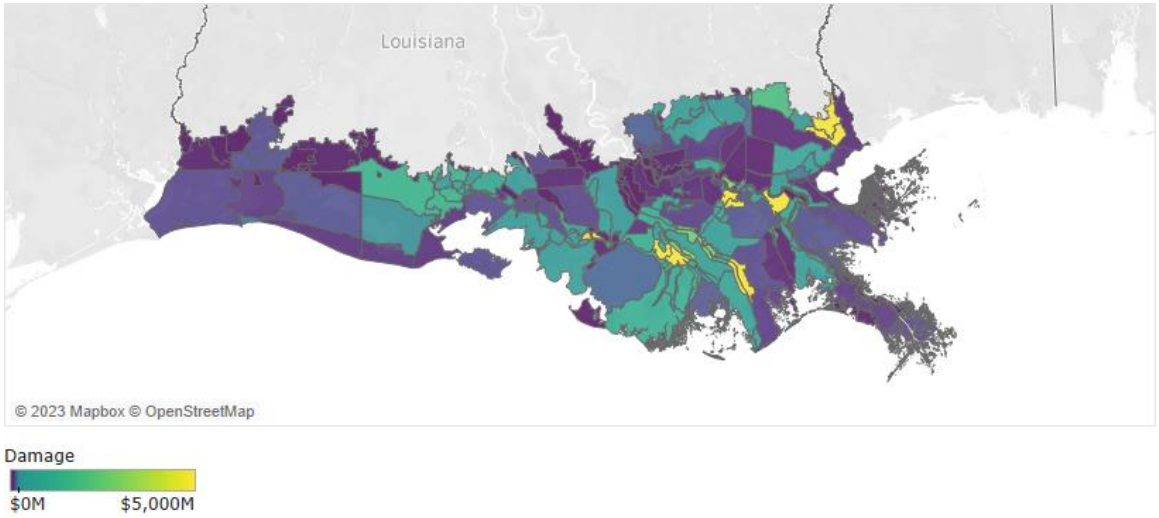

Figure 59. Economic damage for Storm 573 (FWOA, Year 10, S07).

FWOA WITHOUT COASTAL FORESTS (YEAR 10) ECONOMIC DAMAGE

Few observable differences in the overall damage patterns resulting from Storm 573 in a FWOA are noted when coastal forests are removed from the landscape (Figure 60). The extent of the damaged area remains largely consistent as does the range of damaged observed in each community, with the exception of Gonzales/Prairieville, which is expected to experience slightly higher damage levels in a FWOA without coastal forests. An examination of the change in modeled future economic damage between a FWOA with and without coastal forests for Storm 573 reveals significant increases in damage in several locations when coastal forests are removed (Figure 61). Notably, this includes two highly populated suburban locations, the highly urbanized communities on the west bank of the Mississippi River in Jefferson Parish, part of the New Orleans–Metairie–Kenner metropolitan statistical area, and Gonzales/Prairieville, part of the Baton Rouge metropolitan statistical area located in Ascension Parish. CLARA results also identified Thibodaux/Lafourche Crossing/Bayou

Country Club in Lafourche Parish, part of the Houma–Bayou Cane–Thibodaux metropolitan statistical area, as a location likely to experience notable levels of additional damage in a FWOA without coastal forests.

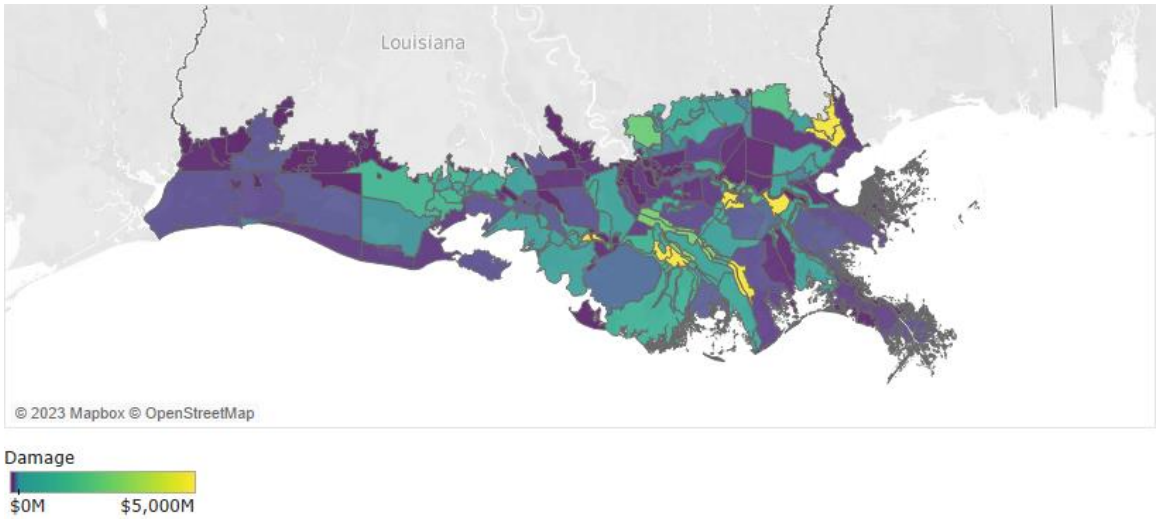

Figure 60. Economic damage for Storm 573 (FWOA without coastal forests, Year 10, S07).

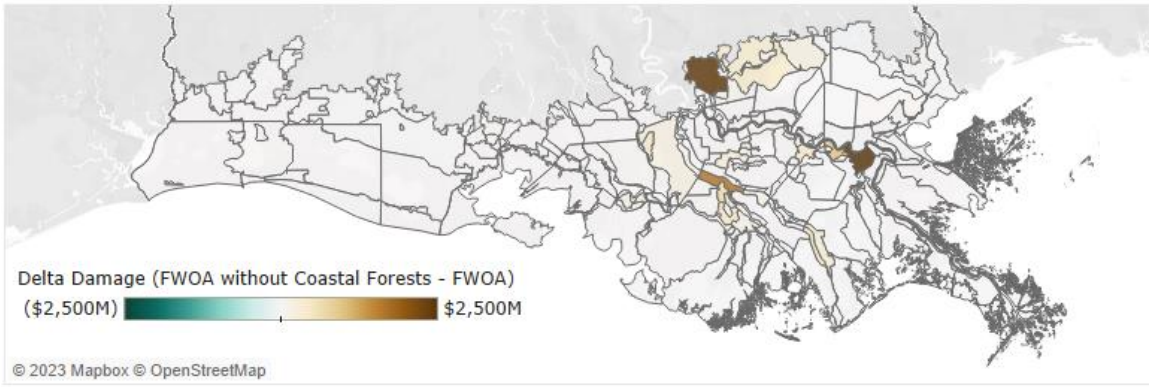

Figure 61. Change in economic damage between FWOA and FWOA without coastal forests for Storm 573 (Year 10, S07).

While CLARA results found the highest levels of economic damage from Storm 573 in densely populated communities such as Houma and Bayou Cane, very little difference in damage was observed when a FWOA without coastal forests was compared to a FWOA with coastal forests. In Houma, removing coastal forests from the CLARA analysis resulted in a 1% increase in expected damages while the impacts on Bayou Cane under the same simulation result in an increase of 6%.

However, the Thibodaux/Lafourche Crossing/Bayou Country Club community (part of the Houma–Bayou Cane–Thibodaux metropolitan statistical area) is expected to experience a 152% increase in damage without coastal forests, from $1.1 billion to $2.8 billion (Table 5). In a FWOA with coastal forests in place, Houma is expected to experience the highest damage levels across the coast. However, when coastal forests are removed from the analysis, Jefferson Parish (Westbank), with a 128% increase in damage, is shown to have the highest damage. Avondale/Waggaman, another community located on the west bank of the Mississippi River, is expected to experience a sharp increase in damages in a FWOA without coastal forests, with a predicted increase in damage of 136%.

CLARA simulations also identified several other communities located on the west bank of the Mississippi River upriver of Jefferson Parish being heavily damaged by Storm 573 in a FWOA without coastal forests. The removal of coastal forests is also predicted to result in high damages in the communities located to the north and west of Lake Maurepas, including Ponchatoula/Springfield, Port Vincent/French Settlement, and Gonzales/Prairieville.

Table 5. Communities expected to experience a 50% increase in flood damage from Storm 573 (FWOA and FWOA without coastal forests, Year 10, S07)

Community	Parish	FWOA Flood Damage (Year 10)	FWOA without Coastal Forests Flood Damage (Year 10)	Delta Damage % (FWOA without Coastal Forests - FWOA)
Napoleonville/Labadieville/Supreme	Assumption	$0M	$43M	>1000%
Gramercy/Lutcher	St. James	$0M	$4M	>1000%
Gonzales/Prairieville	Ascension	$98M	$2,534M	>1000%
Glencoe	St. Mary	$1M	$6M	654%
Ponchatoula/Springfield	Tangipahoa	$28M	$198M	601%
Killona/Taft	St. Charles	$64M	$360M	461%
Port Vincent/French Settlement	Livingston	$20M	$105M	421%
Schriever	Terrebonne	$309M	$971M	214%
Edgard/North Vacherie/Wallace	St. John the Baptist	$37M	$110M	199%
Hahnville	St. Charles	$152M	$399M	163%
Thibodaux/Lafourche Crossing/Bayou Country Club	Lafourche	$1,099M	$2,768M	152%
Avondale/Waggaman	Jefferson	$718M	$1,694M	136%
Pierre Part	Assumption	$358M	$828M	131%
Jefferson Parish (Westbank)	Jefferson	$6,497M	$14,789M	128%
Gray	Terrebonne	$509M	$817M	61%

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